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HANDBOOK

FOR THE

6-INCH B.L., MARKS IV V, & VI GUNS.

1892.



LONDON:

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY HARRISON AND SONS, ST. MARTIN'S LANE,
PRINTERS IN ORDINARY TO HER MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE & SPOTTISWOODE, EAST HARDING STREET, FLEET STREET, E.C.; or
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HODGES, FIGGIS, & Co., 101, GRAFTON STREET, DUBLIN.

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Note.—This handbook is corrected up to March, 1892.

Any alterations which may be suggested should be forwarded to Assistant-Director of Artillery, Woolwich.

Ordnance B.L. 6-inch, Marks IV, V, & VI.

GUNS.

Plates I to V.

				Marks IV & VI*	Mark V.
Material	...	...	...	Steel	Steel.
Weight, nominal	...	...	...	5 tons	5 tons.
Preponderance	...	...	...	nil	120 lbs.
Length, total	...	...	...	173.5 inches	195.3 inches.
Bore	length	calibres	...	26...	30.6.
	length	inches	...	156 inches	183.5 inches.
	calibre	...	...	6 inches	6 inches.
Chamber	capacity, including chamber and grooves	...	...	5,080 c. inches	5,877 c. inches.
	length	...	...	26.75 inches	31.75 inches.
	diameter	...	...	8 inches	8 inches.
Rifling†	capacity	...	...	1,364 c. inches	1,515 c. inches.
	system	...	...	polygroove, hook section	polygroove E.O.C.
	twist	...	...	increasing from 1 in 120 calibres at breech to 1 in 35 at 61.75 inches from muzzle, the remainder being uniform 1 in 35	increasing from 6 at breech to 1 turn in 30 at muzzle.
System of obturation	length	...	...	126.875 inches	149.75 inches.
	grooves	number	...	24...	28.
		depth	...	0.05 inch	0.05 inch.
Firing arrangement	width	...	...	0.6 inch	0.45 inch.
Vent	...	...	...	pad	E.O.C. cup.
				percussion lock	percussion lock.
				axial	axial.

MARK IV GUN.

Plates III and IV.

The gun consists of a toughened steel A tube, over which are shrunk the breech-piece, B tube, and three hoops. A jacket with trunnions is shrunk over the breech-piece, and a short hoop, C, is shrunk over the B tube in front of the trunnions. A hood, D, is attached by screws to the jacket to protect the breech fittings.

* The Mark VI gun differs from the Mark IV in the method of hooping the chase, which in guns of the latest manufacture is made in one piece. The fittings and sights are interchangeable for either Mark of gun.

† Guns of future manufacture, and also when "through lined," will be rifled with a uniformly increasing twist from 1 turn in 60 calibres at the commencement to 1 in 30 at muzzle.

Breech Fittings.

The breech is closed by a screw having three portions of the thread removed longitudinally, each one-sixth of the circumference. The interior of the gun at the breech being prepared in a similar manner, admits of the screw, when the raised portions are placed opposite the smooth surfaces in the gun, being pushed home, and locked by the sixth of a turn.

The screw has hinged to it a cam-lever, by which it is locked and unlocked; the cam portion of this lever (when the breech-screw is locked) falls into a recess in the carrier ring, and so prevents any movement of the breech-screw during firing. In depressing the cam-lever after the breech-screw is unlocked, the cam acting upon the surface of the carrier ring, partially withdraws the breech-screw together with the obturator.

The lever, when in the locked position, is held by a clip at its lower end, to prevent it from flying up during recoil.

Encircling the rear end of the breech-screw and hinged to the hood is a carrier ring, which supports the screw when withdrawn.

On the outer face of the breech-screw is a stud, which, coming in contact with a projection on the carrier ring, forms a stop when the screw is unlocked.

The carrier ring is held to the gun during the withdrawal of the breech-screw by a "clip" pivoted within the left side of the ring, engaging with a recess in the hood.

A stop bolt in the right side of the carrier ring prevents the breech-screw being disengaged from the carrier when withdrawn: at the same time the clip is disengaged from the recess in the hood by means of a spring, which forces its opposite end into a recess in the breech-screw, thus securing the latter in the carrier ring. When in this position the whole can be swung clear of the breech opening, to admit of loading.

The ring is retained in the loading position by a spring "latch."

In closing the breech, the upper arm of the clip is elevated by coming in contact with an inclined plane in the hood, and the clip being pivoted is consequently released from the recess in the screw leaving it free to be pushed home.

The system of obturation consists of a circular pad, with protecting discs fitting the mouth of the chamber, being placed between the mushroom head of the axial vent and the breech-screw.

The pad being slightly elastic, expands radially when compressed by the action of the powder gas, thus sealing the escape.

Thin discs of steel are used to adjust the required thickness of the obturating pad.

Firing Mechanism.

The percussion firing arrangement is designed to prevent the gun being fired before the screw is in its locked position.

It consists of a steel vent passing through the longitudinal axis of the breech-screw, having secured to its outer end a box in which the percussion lock slides, the latter being pushed into a position over the vent, when the breech is being closed, by a bolt gearing with a cam-groove in the carrier ring, and by the action of an inclined spring guide on the carrier. Should there be a projecting tube in the vent, the spring of the guide yields, to prevent the shearing of the tube.

The percussion lock consists of a frame (a) containing a hammer (b), actuated by the main spring (c). The hammer is retained in its elevated position by a trigger (d). A sliding hammer guard (e) is fitted to the frame, and has upon its upper surface two parallel rectangular projections (ff), placed immediately under two similar projections (gg), on the hammer.

The lock, which acts automatically with the closing of the breech, contains a striker (h) for transmitting the blow from the hammer to the tube. A lanyard bolt (i), having one side bevelled, is fitted to the slide box (j). When the lanyard bolt is pulled, the guard is pressed aside, which removes the projections from under the hammer, and at the same time acts upon the trigger, thereby releasing the hammer, which is now free to fall on the striker. The guard, which is acted on by a spring, prevents contact between the hammer and the striker, except when the lanyard bolt is pulled. The cam-groove in the carrier ring retains the lock in such position that the striker is not immediately over the tube till the breech-screw is locked. Without opening the breech, the guide bolt (k) can be withdrawn from the cam-groove by turning the cross-handle, to allow the lock to be drawn back for inserting a tube in the vent, or changing it in case of a miss-fire. When the breech is open, the lock is retained in the grooves of the slide box by a spring stop-pin.

Sights.

The gun is sighted on both sides. The foresights are of the drop pattern, and each consist of a pillar, jacket, and socket, with a steel acorn screwed into the pillar. The sockets are permanently fixed in the gun; the pillar and jacket each lock into it with a bayonet joint, so that when once the sight is in its true position, it cannot be removed without first raising the jacket and turning the pillar round a quarter of a circle.

The tangent sights consist of steel bars triangular in section. On the front face is a degree scale, and a rack which gears with the pinion in the automatic clamp. The rear faces are fitted with range strips graduated in yards for a full charge, and stamped with the corresponding M.V. The cross-head is fitted with a deflection leaf, worked by a screw capable of giving 2° deflection right and left. The leaf has a vertical sight blade of a height corresponding to about a mean length of 1,000 yards on the yard scale, and also a sight notch 0.06 inch deep. On the leaf is engraved a zero mark, and the deflection scale is engraved on the corresponding upper face of the cross-head.

The sight blade is intended for use in conjunction with the elevation indicator, elevation being given by means of the latter, and line only by the sights. When using the sight blade, the sight should be clamped about 1,000 yards less than estimated range of the ship, if the ship is approaching, and at the estimated range if the ship is going away, as by this means the gun can be laid for line at any time during the period the ship takes to move 1,000 yards.

The notch is for use when elevation and line are both to be obtained by means of the sight.

Reflecting sights Δ E are fitted on the elevators A. These will give direction only. The carriage must be trained until the object which is reflected from the top to the bottom mirror is exactly opposite the copper wire on each mirror.

The graduated arc on the carriage will be used in conjunction with these sights to give elevation or depression.

Pointers are also provided on the top of the shields for obtaining direction.

MARK V GUN.

Plate V.

The gun consists of an A tube, over which are shrunk a breech-piece and "1 B," "2 B," "3 B," and "4 B" hoops extending to the muzzle. Over the breech-piece and "1 B" hoop are shrunk the jacket, trunnion, and "1 C" hoop.

Breech Fittings.

The mechanism for closing the breech is on the interrupted screw system.

The screw, when withdrawn from the gun, rests on a gunmetal carrier, P, hinged on the right side, so that the screw can swing clear of the bore for loading.

The obturating cup, A, is fixed to the breech-screw by the axial vent, C, and fits into a copper seating in the gun.

The carrier, P, is fitted with catches which lock into recesses in the gun, to hold it in the firing or loading position.

To close the breech, the screw is pushed into the gun, and the cam-lever, L, is pulled over to the left 60°, against the stop. The cam-lever is then turned down into dotted position (as shown on drawing), when the projection on it locks into a recess in the gun, and prevents any movement of the breech-screw when the gun is fired.

When the breech-screw has been unscrewed after firing it can be started by turning down the lever, which causes the projection on it to bear against the face of the gun.

Should there be any difficulty in unscrewing the breech-screw or in putting the lever down by hand, the small lengthening lever will give ample power.

Firing Mechanism.

The gun is vented axially, and is fitted with central firing gear, viz.: a percussion lock, consisting of a frame containing a hammer, actuated by a main spring, and a trigger, which retains the hammer in its elevated position. A sliding hammer guard, having on its upper surface two parallel rectangular projections, placed immediately under two similar projections on the hammer. A striker transmits the blow from the hammer to the percussion tube. The fall of the hammer is effected by pulling a lanyard-bolt, which presses the guard, and also acts on the trigger, at the same time the projections on the guard are moved from under the hammer. The guard, which is acted on by a spring, prevents contact between the hammer and its striker except when the lanyard-bolt is pulled.

To prevent the gun being fired before the breech is properly closed, a cam-groove retains the lock in such position that the striker is not immediately over the tube till the breech screw is home.

Without opening the breech, a tube may be inserted in the vent, or changed in case of a miss-fire, by withdrawing the guide-bolt from the cam-groove, and drawing back the lock.


The axial-vent, which has a rounded head at the inner end behind which the obturating cup is placed, is held at the outer end by a slide box in two parts, retained in position by two keys secured by pins.

Sights.*

The gun is pierced for sights on both sides, and is provided with three sights, viz. :—

- (a) One breech tangent sight.
- (b) Two fore sights.

(a) The tangent sight is of steel, graduated up to 15° , and fitted with a sliding leaf and adjusting nut for small vertical adjustment.

The bar is of  section, and is inclined at an angle of $1^\circ 30'$ to the left of the vertical, to compensate for deviation due to twist of rifling.

If any correction in deflection is required on account of wind, or any other cause, it can be given by moving the deflection leaf in the required direction.

(b) The fore sights consist of the gunmetal socket, and jacket with steel pillar, fitted at the top with a hog-backed sight.

The socket is permanently fixed in the gun, and the pillar and jacket each locked into it with a bayonet joint. To remove the sight the jacket should be raised, and the pillar turned a quarter of a circle, when the sight can be lifted out of the recess.

Reflecting sights Δ E and pointers on the shields of such mountings as are fitted with them, are also provided similar to those for Mark IV gun.

GENERAL INSTRUCTIONS FOR CARE AND PRESERVATION OF GUNS.

The guns should be examined after firing every 100 rounds with projectiles.

The bores of guns, from which practice is carried on, should be kept slightly oiled, to prevent rusting. At the close of each day's practice, they should accordingly be washed, and slightly depressed, and when dry oiled with a sponge, the muzzles being then closed with tampeons.

When guns are not likely to be used for some length of time, the whole of the sights, the obturating cup, vent bolt, and percussion lock,

* Tangent-sights, similar to those described for Mark IV, will be issued for these guns. For instructions for laying see page 7.

should be removed, and kept in store, the holes in the guns being filled with plugs of greased tow, to keep out water and dirt. These plugs can be readily removed when it is required to fit the sights, &c., to the guns, and particular attention should be paid to the prevention of rust or grit accumulating in the sight recesses, &c.

The sights and other fittings should be kept clean, free from grit, and oiled; the sliding leaf and elevating nut of the tangent scales, as well as the jackets of the trunnion sights, should have free play.

The exposed portions of the sights are bronzed if made of gun-metal, and blued if of steel. This is done to preserve them from corrosion, and on no account are these parts to be burnished or cleaned in such a manner as to remove the bronzing or bluing.

The bore and all working parts must at all times be kept slightly oiled, and perfectly free from rust.

During firing the male and female screws of the breech must be kept perfectly clean, free from dirt, and well greased with a mixture of oil and tallow. It will be found convenient, although not absolutely necessary, if the number in charge of the breech-screw runs over these surfaces with a piece of oily waste after each round.

The officer in charge of the gun must always see that the safety gear is in good working order, and that the cam-lever is in its proper position before firing.

Special for Mark IV.

In removing the "De Bange" obturator from the gun, care should be taken to keep the wad and rings against each other, and tied with cord, as the edges of the rings are liable to be damaged, when disconnected.

Instructions for the care of the "De Bange" Pad Obturator.

Keep the pad well greased, and before firing take it off the stalk, if possible, and grease it all round. If a pad becomes very hard, soak it in a hot mixture of oil and tallow.

During practice wash the breech-screw and pad frequently with soft soap and water.

Should a pad get too soft, from rapid firing, remove it and place it in cold water. After firing place the pad in cold water.

Causes which lead to stiffness in working the breech:—

1. Pad not in good order.
2. Too many adjusting discs behind the pad.
3. Striker of P lock too long or worked loose.
4. Guide-bolt of P lock driven hard against the side of the cam groove.

Special for Mark V.

Care should be taken that the edge of the obturating cup attached to the breech-screw, and intended to prevent the escape of any gas, is kept uninjured and free from burrs. Should any burrs or notches be observed, the cup should be removed and replaced by another one; this operation can be performed in a minute or two. Abrasions on the edge of the injured cup can generally be removed with a dead smooth

file. The proper action of the obturating cup depends upon the slightly convex form of the base upon which it rests. Each time the gun is fired the flat underside of the cup is forced, by the pressure of the gas, to take the form of the base, and the circumference is thereby expanded, so as to tighten against the copper seating in the gun. If the underside of the obturator should, by continued firing, partially lose its flatness, and take a permanent hollow form, it should be fed forward by inserting beneath it one of the thin brass discs provided for the purpose. These discs are of two thicknesses, to meet different degrees of hollowness. Care should be taken that the cam-lever bracket does not close against the stop without the exercise of a moderate force. In pulling the cam-lever down, a toe piece on it will lock into a slot in the gun, and force the cam-lever bracket against the stop.

It may occasionally happen after repeated firing that the copper seating for the obturating cup will become expanded. If this occurs, the cup may become injured on account of its not receiving sufficient support from the seating. With each gun two obturating cups, of somewhat larger diameter than the ordinary size, are supplied, and one of these must be substituted when the copper is large enough to allow of its use.

Should the copper ring become damaged or ineffectual in preventing the escape of gas even when the larger cup is used, it must be replaced by a new one. Special tools are provided for this purpose. A full description of this operation, and the tools required for it, will be found in the chapter on Preservation and Repair of Ordnance in the "Treatise on the Manufacture of Guns."

Reflecting sights, ΔE , are fitted on the elevators, A, and are for use in sighting the gun under cover of parapet. The carriage must be trained until the object (which is reflected from the top to the bottom mirror) is exactly opposite the copper wire on each mirror.

MOUNTINGS.

Plates VI to XIX.

	Carriage, Garrison, Disappearing, B.L. 6-inch Mark	I.
	" " " " " "	II.
†	" " " " " "	II*.
	" " " " " "	III.
	" " " " " "	IV.
	(Plates XXVII to XXIX.)	
	" " Barbette " "	I.
	" { B.L. 6-inch Vavasseur }	
	" { Central Pivot }	I.

H.P. MOUNTINGS.

There are five marks of disappearing hydro-pneumatic carriages, all made on the same principle, but differing from one another in more

† The Mark II* mounting is the Mark II made by R.C.D. In demanding new parts, etc., this should be noted.

or less important details of construction. The Marks I and III are for Mark V gun; the Marks II and IV for Mark IV and Mark II P guns.

Marks II, III, and IV are very similar to one another, and are easily recognisable from Mark I in that they require no pivot block, are mounted on live-roller rings, have no check chains to the elevators, are furnished with concentric recoil cylinders and only two sets of traversing gear, &c., &c.

Marks III and IV are suitable for the same roller path.

All the mountings consist of the following parts:—

Rocking carriage or elevator.

Lower carriage with training and elevating gear and overhead shield.

Hydro-pneumatic recoil cylinder with cut-off gear and lowering pump.

MARK I MOUNTING.

Rocking Carriage.

Plate VI.

The rocking carriage consists of two steel cheeks or elevators, A, connected by steel diaphragms. At the lower ends of each elevator is a wrought-iron pin, R, upon which it oscillates, and at the other ends are bearings for the gun trunnions. About the centre of the overbank carriage is a cast-steel crossband, K, which is attached to the recoil ram, J, by means of a socket and cottar.

The object of this carriage is to elevate the gun from the loading position, under cover of the parapet, or *vice versa*. The check chains, P, are attached to brackets, O, on the lower carriage, and to bolts on the elevators, and limit the stroke of the ram, thus preventing the gun being carried too far forward. Arrow heads on left elevator and its bracket show when the gun is fully run up.

The carriage admits of 15° elevation and 5° depression.

Lower Carriage.

Plates VI and VII.

The lower carriage is made up of two steel girders or cheeks, AA, which are connected by steel transoms CC at the front, and BB at the rear. The carriage is mounted on four steel trucks, S, which run on a steel racer, X, fixed to the masonry. A buffer, N, is fitted on each cheek, which acts as a cushion in case the recoil of the gun is excessive. A steel pocket is bolted to the inside of each cheek, to receive the trunnions of the recoil cylinder, H. On the underside of the carriage are fitted steel clips,* Z, at the front and rear, which engage a cast-iron clip ring, Y, fixed to the concrete. Two elevator brackets, Q, are fitted to the front of the carriage which take the pins, R, of the elevators.

* Spare wrought steel clips of stouter make, with a set of bolts for attachment, are issued with each mounting. The holes for these bolts may require re-tapping.

A sighting ladder and platform, Δ , is provided for use in sighting with the ordinary service sights. The platform consists of a hinged foot plate, which is brought into a vertical position by means of a spring after use, thus keeping it clear of the gun when ascending and descending.

An overhead shield,* Δ J, supported on eight pillars, Δ H, is supplied. These pillars rest in sockets, KK, LL, MM, on the lower carriage.

Traversing Gear.

Plate VI.

The traversing gear is fitted at the front and rear of the carriage and is actuated by four handwheels, W. On turning these, the pinions, U, on the shafts, V, with the handwheels, engage spur-wheels, T, fixed to the trucks, S, and the carriage is consequently traversed. When the gun is in the firing position the front gear should be used, and the rear when the gun is down.

Elevating Gear.

Plates VI and VII.

The elevating gear is fixed on both sides of the carriage, and is worked by means of a handwheel, SS, on the right side. The handwheel is fixed on the spindle, VVV, which passes through a bush, UUU, fixed in the carriage cheek, and has a pinion, RR, formed on it, which engages the spur-wheel, QQ. This is carried on the shaft, WWW, but is free to rotate on it. The inner face has a coned recess turned on it, in which the friction cone, WW, fits. The part of the shaft carrying the cone is hexagonal, and the cone consequently rotates with it. The shaft passes through bushes fixed on the cheeks of the carriage, and has at each end a pinion, PP, which engages the arcs, NN, fixed to the ends of the elevating rods, G, the other ends of the elevating rods being fixed to the gun. The arcs work in gunmetal guides, OO, fixed to the carriage cheek; that on the right-hand side is graduated in degrees of quadrant elevation, the other being graduated after appropriation to the emplacement, due allowance being made for height above the sea-level, &c. The spindle is screwed for nuts, YY, which force the star spring, XX, against the face of the cone. This causes sufficient friction between the cone, WW, and the spur-wheel, QQ, to elevate or depress the gun, but will allow the shaft, WWW, and cone, WW, to revolve without putting all the gear into motion when the strain due to firing comes upon it. An automatic regulating brake is fitted on the shaft, WWW, and consists of a friction cone, CCC, which is keyed to the shaft, WWW, and fits into a recess turned to the drum, ZZ. The springs, DDD, should be screwed up by means of the nuts, EEE, against the wheels, until the power required on the handwheel, SS, for elevating the gun is the same as that required for depressing it.

* This shield is only issued for certain emplacements, and the sockets are only fitted to those mountings provided with shields.

A friction-strap, AAA, works on the drum, ZZ, which is free to move in it when the gun is being elevated, but is made to grip the drum by means of the pivot, BBB, when the gun is being depressed. Elevation or depression can be given to the gun before it is raised to firing position. The gun does not move when in loading position, but takes up the elevations given on the arcs when raised for firing.

Recoil Cylinder.

Plates VIII and IX.

The recoil cylinder, H, has two chambers; one, *a*, contains the recoil ram, J; the other, *b*, is the chamber for containing the necessary supply of liquid and air. These two chambers are connected by two recoil valves, JJJ and KKK, and a by-pass or raising valve, access to the former being obtained by a wrought-iron cover, M, secured with eight studs, and jointed by a leather ring. The valves JJJ, KKK should be adjusted* so that the gun recoils gently on to the stops N (Plate VI), or near enough to them to allow of easy loading. The adjustment must be made with great care, a very slight increase in the opening of the valves making considerable difference in the amount of recoil. When once adjusted the valves must never be touched. In the cover, M, are two tapped holes for eye-bolts, for convenience in lifting it. At the bottom of one of these holes is a smaller hole, connected to an annular channel immediately over the leather joint, the object of which is to allow any liquid which may pass the joint to escape, thus preventing it from exerting any additional stress on the bolts by acting on a larger area. When water is observed escaping from these holes it is a proof that the cover, M, is not tightly fastened down. The top end of the recoil cylinder is fitted with a packing gland, I, which consists of the following parts:—

A gunmetal ring, carrying the cup-leather ring, is fitted into a recess prepared for it; over this cup-leather ring is placed the gunmetal gland, containing a recess for hydraulic packing, which is tightly compressed by a screwed gunmetal ring. The object of the cup-leather ring is to prevent the escape of liquid when the pressure is high, and that of the spun-yarn packing to prevent its escape when the pressure is low. There is also a flat leather ring to prevent the escape of any liquid which may pass outside the cup-leather ring.

On the left-hand side of the air chamber is a filling-cock, GGG, which is connected by a copper tube with a nozzle on the left bracket of lower carriage to which the pressure pipe from the pump is attached; the plug *n* is raised and the liquid or air pumped into the chamber. When the pumping is finished the plug is screwed down, and the pumps can be disconnected from the lower carriage. A water-level cock, HHHH, is inserted on the upper surface of the cylinder, the use of which is explained in the instructions for working the gun.

The action of the recoil cylinder is as follows:—

The requisite quantity of liquid having been pumped into the air-chamber, air is then pumped in to a pressure of 1,350 pounds per

* For this purpose a certain number of rounds may be expended, commencing with $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ charges. See pp. 29 and 31.

square inch. The only means of entrance for the pressure from the chamber *b* to the ram chamber *a* is through the by-pass valve; this being opened, the compressed air forces the liquid behind the ram, *J*, and so pushes the ram out, thus raising the gun to the firing position. The by-pass valve is now shut and the liquid in the cylinder has no way of return into the chamber except through the recoil valves.

The pressure of air in the chamber when the gun is up will be found to be reduced to 570 pounds per square inch. When the gun is fired the force of recoil presses back the ram, *J*, expelling the liquid through the recoil valves at such a velocity as to partly absorb the recoil energy, the remaining portion of the energy being taken up in compressing the air into its original volume.

Before charging the cylinder for service, it is advisable to partially charge it and allow the pressure to act on the cup-leather in the gland, *I*, for some little time; the longer the better. This softens the leather and keeps it tight. When the cylinder is once properly charged it will retain the charge for a considerable time; but should there be any slight leakage this can readily be made good by the use of the air pump.

Cut-off Gear.

Plates VIII and X.

This gear is provided to close the by-pass or elevating valve, when the gun is in firing position, thus preventing an undue strain on the check-chains, *P* (Plate VI). When the gun ascends into firing position the valve is closed by means of the steel cord, *LLL*, which is attached to the elevators and to the crank lever, *QQQ*, on the valve spindle, *OOO*. The handle, *Δ A*, should be pulled from the carriage when the gun is in firing position, to ensure the valve being perfectly closed. The adjustment of the cord requires some care. The gun should be run up to the fullest extent, and the cord then should be attached and securely fastened. The second time the gun is run up it should be noted whether the cord acts correctly in closing the by-pass valve when the gun is fully up. If not, the cord must be tightened up; it is apt to stretch.

Lowering Pump.

Plates VI, VII, VIII and IX.

A pump, *YYY*, is provided on the right-hand front face of the rear transom *BB*. It is actuated by the handle *MMM*, and is connected with the recoil cylinder by means of two copper pipes running respectively to a suction connection *III* at the bottom of the chamber *a*, and an inlet *XXX* in the cover *M* of the chamber *b*. By the action of the pump liquid is pumped from the chamber *a* into *b*, and the gun can be thus lowered into the loading position in the event of it not recoiling sufficiently, or if it is not required to fire the gun after having been raised into firing position. See also General Instructions.

Pivot, Racer, and Clip Ring.

Plates VI and VII

The lower carriage is mounted on a centre pivot. A heavy casting, GG, fitted with wrought-iron pivot pin EE, is firmly bedded in concrete under the centre of the carriage, and fixed by the bolts II, and anchor plates JJ. A cross girder, or pivot beam DD, carrying a brass bush, is fitted to the underside of the lower carriage. The pivot-pin enters this bush, and is held in position by a tapered cottar FF. None of the weight of the gun or carriage is taken by the pivot, the underside of the bush being slightly clear of the top of the pivot.

The racer X is made of steel, and is in six lengths, fitted at each joint with a joint-plate. The latter are fixed to the masonry by means of tap bolts passing through the flange in the racer into square tapered nuts fixed in the masonry by means of lead or cement. They should be laid level in one horizontal plane, and carefully bedded.

Between the pivot block and racer is laid a cast steel clip ring Y, held in the concrete by the bolts HH and anchor-plates JJ.

It is most important that the pivot block, racer, and clipring should be laid level and accurately, according to dimensions.

After firing a few rounds the nuts of all bolts should be tightened up if necessary.

The heads of the bolts II of the pivot block should be cut off flush with the nuts, as otherwise the bottom of the recoil cylinder, during recoil of the gun is liable to strike against them.

The pivot should only take a bearing when the load comes on the centre of the mounting due to the downward pressure of the recoil. The pivot beam DD would spring several hundredths of an inch and then get additional support on the pivot. The clearance between the pivot beam and cottar of the pivot should be as small as possible, so long as enough is provided above the probable wear of the racer, trucks, and bearings, about 0.03 inch. The clearance between clips and clip ring should also be as slight as possible, about .05 inch. The pivot beam and cottar should have a clearance of about half this amount.

Instructions for working the Mark I H.P. Carriage.

To prepare the carriage for action the pumps must be attached to the recoil cylinder,* the raising valve opened, and liquid† pumped into the cylinder until it overflows at the air cock, after which the raising valve should be closed.

To prevent the gun from rising during the operation of pumping in the air, a wood block Δ D (Plate X) is placed on the lower carriage under the gun, and the securing chains and links Δ C attached as shown in sketch—the screws are tightened by means of a "tommy" key supplied for the purpose.

* The pump handles are on no account to be worked until the plug of the filling cock has been raised.

† About 14 gallons of the following mixture:—Methylated spirits, 7 gallons; filtered water 3½ gallons; pure mineral oil, ½ gallon; carbonate of soda, 250 grains. The liquid must be quite clear of dirt or grit.

Air should be pumped into the chamber of the cylinder. This operation should be performed carefully, and under the inspection of a competent officer, as upon the correctness with which it is done depends the safe working of the carriage.

Valves I and J (Plate IX) must be screwed down, and the small cock *h* opened to such an extent that the flow of liquid through it be not in a continuous stream, nor in distinct drops, but in drops following each other so closely that they are almost connected.

As the liquid gets pumped into the cylinder along with the air, it must now and then be blown out at the water level cock, so that when the required pressure of 1,350 lbs. per square inch is reached, only air saturated with vapour of liquid should escape when this cock is opened. The filling cock on the cylinder should then be shut, and the pumps disconnected.

When the pumps are being worked the cock in the pressure gauge should be shut, to prevent damage to the gauge.

Whilst liquid only is being pumped into the cylinder, or air at a low pressure, four men are able to do the work, but afterwards as the work increases eight men will be required.

To raise the gun into firing position, the securing chain is removed, and the raising valve is to be opened by pushing the handle Δ A (Plate VIII) towards the carriage, and left open until the check chains P (Plate VI) are tight when the cut-off gear will close the valve. When the gun is raised for firing, its exact position is determined by the check chains as before intimated. In case the cut-off gear does not act perfectly, the handle Δ A closing the valve should always be pulled from the carriage before firing.

To insert a new cup-leather in the gland I of the recoil cylinder, see general instructions.

Weights.

					tons	cwts.	qrs.	lbs.
Carriage	..	..	..	..	.6	4	1	24
Shield complete	..	..	..	..	7	3	1	13
Cylinder and ram	..	..	..	..	1	3	3	21
Pivot bracket, pin and bolts	..	..	..	..	1	1	1	19
Racors, steel, with plates and bolts..	..	..	..	..	0	14	3	25
Clip racer	..	..	..	..	1	10	2	20
Force pump and gauge	..	..	..	..	0	8	3	2
Sighting ladders	..	..	..	..	0	4	0	16
Total	..	..	..	..	18	11	3	0

List of Names of Parts for Carriage, Garrison,
Disappearing, B.L., 6-inch, Mark I.*

- A. Elevator, right and left.
- B. Upper transom of elevator.
- C. Lower " "
- D. Capsquare of trunnion.
- E. Gun elevating band.
- G. Elevating rod.
- H. Recoil cylinder with air chamber.
- I. Brass packing gland (3 parts).
- J. Recoil ram.
- K. Crosshead of recoil ram.
- L. Recoil cylinder securing cottar.
- M. " " cover.
- N. Buffer.
- O. " bracket.
- P. Check chains.
- Q. Elevator bracket (right and left).
- R. Pin for elevator bracket.
- S. Truck.
- T. " spur wheel.
- U. Traversing pinion.
- V. " shaft.
- W. " handwheel.
- X. Racer.
- Y. Clip ring.
- Z. Holding down clip.
- AA. Girder (right and left).
- BB. Rear transom.
- CC. Front transom.
- DD. Pivot beam.
- EE. " pin.
- FF. Securing cottar for pivot pin.
- GG. Pivot block.
- HH. Clip ring anchor bolts.
- II. Pivot block anchor bolts.
- JJ. Anchor plates.
- KK. Shield pillar bracket inner
- LL. " " " front
- MM. " " " rear
- NN. Toothed elevating arc (right and left).
- OO. Guide for " " "
- PP. Pinion for elevating arc (outer and inner).
- QQ. Elevating spur wheel.
- RR. Pinion for elevating spur wheel.
- SS. Elevating handwheel.
- TT. Truck bracket (outer).
- UU. " " (inner).
- VV. Foot boards.
- WW. Friction cone.

* The same names apply to the other Marks when the parts are similarly lettered in the Plates.

- XX. Spring for spur wheel friction cone.
 YY. Adjusting nuts for spring for friction cone of elevating spur wheel.
 ZZ. Drum non-return brake gear.
 AAA. Strap for " " "
 BBB. Pawl " " " "
 CCC. Cone " " " "
 DDD. Spring " " " "
 EEE. Adjusting nuts for " "
 FFF. Buffer springs in ram head (Plate XIII).
 GGG. Recoil cylinder filling cock.
 HHH. " " water level cock.
 III. Suction connection to lowering pump.
 JJJ. Recoil valve No. 1.
 KKK. " " No. 2.
 LLL. Steel cord for cut-off gear.
 MMM. Handle of lowering pump.
 OOO. Raising valve spindle.
 PPP. " " working rod.
 QQQ. " " " lever.
 RRR. Gland for raising valve.
 SSS. Securing plate for gland for by-pass valve.
 TTT. Cottars for crosshead.
 UUU. Bracket for elevating hand-wheel spindle.
 VVV. Elevating hand-wheel spindle.
 WWW. Elevating shaft.
 XXX. Delivery connection for lowering pump.
 YYY. Lowering pump.
 ZZZ. Guide plates for check chains.
 Δ Sighting ladder and platform.
 Δ A. Handle for working raising valve.
 Δ B. Securing chain for raising valve.
 Δ C. Securing links for gun, housing position.
 Δ D. Block for " " "
 Δ E. Reflecting sights, upper and lower.
 Δ F. Tie rods for front pillars.
 Δ G. " " rear "
 Δ H. Shield pillars, front and rear.
 Δ J. Shield.
 Δ K. Rough sights (Plate XI).
 Δ L. Live roller ring "
 Δ M. Air plug (Plate XIII).
 Δ N. Training pointer (Plate XI).

MARK II. MOUNTING.

The carriage consists of the following parts:—

- | | |
|--|----------------------|
| 1st. Rocking carriage, with crosshead .. | } Plates XI and XII. |
| 2nd. Lower carriage with live-roller ring .. | |
| 3rd. Recoil cylinder and ram .. | Plate XIII. |
| 4th. Elevating and traversing gear .. | " XIV. |
| 5th. Cut-off gear | " XIV. |
| Air-pump | Plates XX and XXI. |

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Rocking Carriage.

Plate XI.

The rocking carriage or elevator only differs from the Mark I in altered dimensions. The attachment of the crosshead to the ram, however, is different, a buffer of disc springs being interposed. FFF', Plate XIII.

When the gun is raised for firing, its correct position is determined by small brass indicators fixed on the left trunnion of elevator and on the lower carriage. Projections on the lower end of the ram bearing against shoulders at the upper end of the recoil cylinder will limit the stroke of the ram, and prevent the gun being carried too far forward, but it is better not to allow these to come into contact. It is to prevent damage in case they do come in contact by the impetus of the gun, &c., that the springs are fitted to the head of the ram.

The carriage admits of 20° elevation and 5° depression.

Lower Carriage.

Plates XI and XII.

The lower carriage also differs from the Mark I in general dimensions, and also in outline. But the principal difference is that the four fixed trucks are replaced by a live-roller ring ΔL , containing flanged rollers S, which run on the roller path or racer X—which is bolted to the concrete. The lower carriage rests on the rollers, an upper roller path X' being bolted to its under surface. There is no pivot, the rollers being kept to their paths by the flanges.

There is in addition a sighting ladder towards the front, and two rough sights, ΔK , on the shield, which enable the mounting to be traversed into line before the gun is raised.

A pointer, ΔZ , is fitted to the front of the carriage for use with a graduated arc.

Traversing Gear.

Plates XI, XII and XIII.

The traversing gear is fitted at the front of the carriage, and is actuated by two hand-wheels W. It consists of bevel gear which works the vertical shaft V and pinion U. The pinion engages a rack fixed to the roller path. Traversing being very easy and more under control when worked by only one man, one set of gear may be kept in store as spare.

Elevating Gear.

Plate XIV.

This, as will be seen, is practically the same as for the Mark I. The length of elevating rod, and consequently the radius of the arcs, is different in consequence of the difference in length of gun (Plates VI and XI), as in the Plate a Mark IV gun is shown as mounted on the Mark II mounting.

Recoil Cylinder.

Plate XIII.

The recoil cylinder H is made of forged steel, with steel trunnions on which it oscillates, and a gun-metal recoil ram J. The cylinder is turned to receive the trunnion, which is fixed in position by a shoulder on the cylinder, and four set bolts. The cylinder is provided with an inner chamber *a*, which contains the recoil ram, and eleven smaller chambers *b*, for the necessary supply of liquid and air. The inner chamber is connected to the air-chambers by the "by-pass" or raising valve OOO, and by the recoil valve JJJ through the small channels D'D'. Access to the recoil valve is obtained by the gun-metal plug M. The chambers *b* are connected at the top by small holes E'E', which equalises the pressure in them.

Near the middle of the cylinder on the upper surface is a filling cock GGG, and liquid level cock HHH. An air plug Δ M is also fitted at the top of cylinder, which opens into the inner chamber.

The top of the ram chamber is fitted with a gun-metal packing gland I, which consists of the following parts:—

A ring carrying the cupped leather ring is fitted into a recess prepared for it; over this ring is placed the gland nut, containing a recess for the hydraulic packing, which is tightly compressed by a screwed ring. The object of the cupped leather ring is to prevent the escape of liquid when the pressure is high, and that of the hydraulic packing to prevent its escape when the pressure is low. There is also a flat leather washer, to prevent the escape of any liquid which may pass outside the cup leather ring.

The action of the hydro-pneumatic cylinder is the same as in the Mark I, but the working pressures are 1,250 lbs. per square inch with gun down, and 590 with gun up.

Cut-off Gear.

Plates XIII, XIV, and XXVI (Fig. 2).

This gear is provided to close the raising valve when the gun is in the firing position, thus preventing strain on the head of the cylinder, and also insuring that the gun shall not rise again after firing from the valve being inadvertently left open.

The valve is opened and closed by a toothed pinion *d* (Plate XXVI), with a worm on its shank. The pinion is turned by the rack *f*, and as it turns it withdraws or presses home the valve spindle OOO. The rack is worked by the crank lever QQQ through the connecting rod PPP. The crank is worked either by the hand lever Δ A or the cut-off chain P. The chain P has two branches, one attached to the crosshead, the other to elevator transom, which arrangement prevents the chain sagging and becoming hitched when the gun is down. It has also a right and left screw collar at Δ N for adjusting the cut-off and with jam nuts for clamping it. When the cut-off is automatic the rising of the ram tightens the chain which pulls the crank lever and closes the valve. The chain, &c., must be so adjusted that the valve is *quite* closed when the gun is up.

Roller Path.

The roller path X with clip ring is made of steel, in one casting, and is firmly bedded and bolted in concrete. It should be laid level and carefully bedded.

MARKS III AND IV MOUNTINGS.

Plates XV and XVI.

These are in most essential points similar to the Mark II.

The Mark III only differs from IV in dimensions entailed by the difference in size of the Marks IV and V guns.

The points in which they both differ from the Mark II are:—

- (1.) The diameter, the number of air chambers, and position of trunnions of the recoil cylinder.
- (2.) The raising valve is situated at the top of the under surface of the cylinder instead of at the bottom.*
- (3.) The hand lever of the raising valve is on the right instead of the left side of the mounting, and the arrow heads showing position for gun up are similarly shifted.
- (4.) The retaining clips for holding the elevator down are attached to the buffers instead of as at Δ C, Plate XIV; and are of a different pattern, provided with a padlock.
- (5.) The holding down clips (Z, Plate XI) are different. There are two in front in Mark II which in Mark IV are replaced by one, and the bracket of the traversing pointer is consequently of a different pattern.
- (6.) The pattern of sighting step is somewhat different.

N.B.—Generally speaking the parts of the different marks are non-interchangeable though similar. It is most necessary therefore in demanding any spare part, or making any report, to specify the Mark, and also to quote the Register No. which is stamped on the mounting or racer.

Air-Pumps for Hydro-Pneumatic Carriages.

E.O.C. Pattern.

Plate IX.

The E.O.C. pattern, which was the first issued, consists of four cylinders, Nos. 1, 2, 3, and 4, of different diameters, each fitted with a plunger and placed vertically in a tank of liquid; this serves to keep them cool, and supplies the small quantity of liquid required to be drawn in; in order to ensure that no air is left undelivered at the end of each stroke, it also protects the gland and valve joints by keeping them moist. The cylinders are arranged as shown on drawing, No. 1 being the largest in diameter, and No. 4 the smallest. When in action the plungers of Nos. 1 and 3 are withdrawn while the plungers of Nos. 2 and 4 are being forced into their respective cylinders, and *vice versa*. No. 1 cylinder alone draws in a charge of air at a pressure of 1 atmosphere (14.7 lb. per square inch). A small quantity of liquid is also drawn in by this cylinder, and when its plunger rises, it delivers its

* The air chamber with which the raising valve communicates is consequently and does not contain air.

charge of air to No. 2 cylinder, in which the plunger is falling, and therefore the work to be done in making the stroke increases more equally from beginning to end. No. 1 cylinder having delivered all the air, will, at the extreme end of the stroke, deliver the small quantity of liquid which was also drawn in. This will ensure that there is no air left to expand and reduce the suction for the next stroke. In the same way No. 2 cylinder delivers its charge on the return stroke to No. 3 cylinder and the process of compression is carried a stage further. Then No. 3 cylinder delivers its charge to No. 4 cylinder, and No. 4 completes the compression up to the highest pressure required in the recoil cylinder. By these means the work to be done is more equally distributed over the up and down strokes, instead of being concentrated into the final portion of the stroke, as it would be if only one cylinder were employed.

The handles of the pump are made to take four men on each side and when not in use they may be folded back so as to occupy less space.

In using the pumps it is of great importance to make the full stroke each time, and strike the buffer gently yet with certainty to ensure that all the air is delivered. The liquid in the tank should stand above the level of the tops of the cylinder; when working the pump to force air into the recoil cylinder, the small tap, *h*, at the front of the tank must be opened just enough to let the liquid run into the suction cup *H* in drops so close together that they almost unite into a connected stream.

To set the pumps for pumping air, see that the valves *I* and *J* are screwed hard down. As it is sometimes required to pump liquid with these pumps, two valves are provided on the pipe which joins Nos. 2 and 3 cylinders.

To set the pump for pumping liquid it is therefore necessary to screw up the valve *I* as far as it will go. This gives an opening downward to let the air away which is continued to be pumped by Nos. 1 and 2 cylinders, because the valve has been lifted off its seat, and it also closes the passage between Nos. 2 and 3 cylinders by being screwed up against its top seat. In order to give the water suction to No. 3 cylinder it is necessary also to open the valve *J*; this valve should be raised completely to bring it up to its top seat to prevent air being drawn into No. 3 cylinder through the pipe joining the valves *I* and *J*. It has been found that the addition occasionally of a small quantity of glycerine in the suction cup *H*, helps to keep the joints of the air-pump tight.

"Pump, Air, Double, Carriage, Garrison H.P., Mark I."

Plates XX and XXI.

This pump is intended to charge the recoil cylinders of H.P. garrison mountings with fluid and compressed air.

It consists of two gun-metal cylinders (*b* and *d*) of different diameters, in one casting, with a base plate, on the top of which an iron frame is bolted to form a tank for the fluid while being pumped into the recoil cylinders. The pump cylinders are fitted with plungers (*c* and *e*) actuated by a rocking lever (for each pump), which is supported on brackets rivetted to the tank.

The pump is in duplicate, and is bolted to an iron bedding plate, which is secured to the floor by clips and cottars. It is worked by two *T* handles which are attached to the rocking levers, and are connected

at the top by a link to ensure uniform action. When charging the recoil cylinders with fluid, the fluid is drawn through suction valves (*g*) from the tank into the large pump cylinders, and on the down stroke of the plunger is forced into the small cylinder through delivery valves (*f*). When charging with air the connection between the tank and the cylinders is cut off, by closing the valves (*a*) near the copper delivery pipes, and the air is drawn through a suction valve at the bottom of the large cylinder. This valve is never cut off, but is more heavily weighted than the water valve, and when the water passage is open, liquid is drawn in, in preference to air, provided the strokes are not too jerky.

Either pump can be disconnected if necessary, and worked independently; the delivery of either is cut off by closing the delivery valve *f*. When this is closed, of course the handle must be disconnected so that the pumps cut off may not be worked.

The pump should be kept in store with tanks full of liquid, and so used whether air or liquid is being pumped.

To keep the leathers in good order they should be slightly under pressure. To obtain this, screw one length of the copper tubing on the delivery nozzle, and on the other end of the tube fix the blank cap (with packing leather). Then work the pump with the water valves (*a*) closed until it becomes difficult to move the handles, when the pump may be left, the air in the tubing serving to maintain the pressure obtained. When standing long in store, the pump should be tried occasionally to see that the pressure is still on.

Reservoir and Separator for H.P. Mountings.

Plate XXII.

The reservoir is for keeping in reserve a supply of compressed air for recharging the cylinders of H.P. mountings. It is in the form of a flask with a short neck at one end, which is fitted with a stop cock (*c*) used for charging and discharging the reservoir; the outer end of the cock is screwed to take the nut of the charging pipe, and is protected when not in use by a wrought-iron cap.

The pressure in the reservoir should not exceed 2,000 lbs. per square inch; but when travelling the pressure must not exceed 1,600 lbs.

The separator is to separate the moisture from the air during the process of pumping into the reservoir. It consists of a 1½-inch copper tube, 3 feet long, screwed at both ends. At one end of the copper tube a wrought-iron head (*a*) is fitted, furnished with inlet and outlet valves of gun-metal, and ½-inch copper pipe (*b*), which carries the air and water in a downward direction in the separator. At the other end of the copper tube is a wrought-iron foot, which is fitted with a drain cock of metal. The separator is connected up between the pump and the reservoir to be charged, and the moisture of the air, while passing through the copper tube, falls to the bottom and is blown off from time to time during the operation through the drain cock. When the separator is used it must always be fixed in a vertical position, the inlet and outlet valves being at the top.

It should be remembered that more work will be got out of a reservoir if it is opened to the cylinder with the gun up, than with the gun down, and in getting up pressure from zero with the aid of reservoirs, it will be done more quickly if the gun is allowed to rise.

"Indicator, Pressure Spring Carriages, Garrison, H.P.
Mark I."*

Plates XXIII and XXIV.

This indicator shows the air pressure per square inch in the recoil cylinders of H.P. mountings.

It consists of a small gun-metal cylinder (*a*), surrounded by a steel spiral spring which is contained in a metal casing (*b*). In the centre of the cylinder works a steel ram (*c*), which is screwed into the top of the casing, and the bottom of the casing is formed with a rim, which fits round the cylinder and acts upon the spiral spring. A pointer (*d*) is fixed to the top of the cylinder, and a graduated scale is attached to the outside of the casing.

When the indicator is connected to the filling cock of the recoil cylinder, the pressure of the compressed air on the fluid acts on the bottom of the ram, and overcoming the resistance of the spring, lifts the casing. The cylinder with the indicator remains stationary, and the upward movement of the casing with the graduated scale registers the pressure in the recoil cylinder in pounds per square inch.

In taking pressures the reading to which the indicator *rises* must be taken, and the casing should not be touched. There is considerable friction in the plunger which is allowed for in the graduating; the indicator will not therefore record a *falling* pressure, and the pressure should be let on gradually, and not with a jerk. When it is desired to take a second reading, the connection with the cylinder must be cut off, and the pressure released from the indicator before re-applying it.

When not in use the indicator should, if possible, be kept under a pressure of 50 or 100 lbs. This can be done by means of the dead weight test gauge and the connection mentioned below.

The small leather (*l*) of the plunger must not be touched, and if it fails to act the indicator must be returned into store for adjustment.

The indicator is attached to the recoil cylinder of the mounting by the intervention of a three-way connection, one opening of which (*a*) screws into the filling cock, the opposite one (*b*) takes the pump tube, and the centre one (*c*) the indicator. When the indicator is not on this opening, it is closed by the closing plug (*f*), the nut (*h*) fitting either the plug (*f*), or the foot of the indicator. See (*h*) Plate XXV. There is a cut off (*d*) worked by a spindle (*e*) which closes the way to the indicator while leaving the passage free between pump and cylinder.† The way to the indicator should not be left open while pumping or firing is going on, as the indicator is liable to suffer. When it is desired to leave the indicator on, and detach the pump pipe, the bared nozzle of the connection is closed by a blank cap (with leather washer) supplied for the purpose.

In connecting the indicator it is not necessary that it should be absolutely vertical, an inclination of 10° or 15° degrees is admissible.

The indicator is issued in a box with two spanners.

"Indicator, Pressure, Spring, Mark II."

This differs from the previous pattern in having a larger piston and a stronger spring, the motion being multiplied by a chain and drum

* With some of the earlier mountings "Bourdon" gauges have been supplied; these are circular in form.

† Some of the earlier connections have been issued without this cut off; with these the indicator should be removed while pumping is going on.

moving a hand on a circular dial. There is no leather on the piston, its place being taken by a gland and stuffing box. The packing to be used is asbestos fibre finely shredded and mixed with tallow; this is issued in a tin box with the indicator, and no other packing is to be used.

The indicator is issued in a box with the necessary spanners, packing and instructions. It is much more sensitive than Mark I and will record both a rising and falling pressure with accuracy when properly packed.

"Gauge, Pressure, Dead Weight Testing, Mark I."

Plate XXV.

This is issued to test the accuracy of the Indicator records.

The indicator is screwed into the connection at one end, and fluid pressure applied by means of a plunger (*d*) driven by a hand wheel (*h*) at the other end. A safety valve weighted with marked weights (*w*) releases the liquid, when the pressure per square inch marked on the weights is obtained; the indicator (*m*) should then show this pressure.*

The liquid employed is a mixture of equal parts of glycerine and distilled water, which is poured into the reservoir (*g*) from time to time as required. There are two cut-off valves, one to the indicator and one to the reservoir. As the stroke of the plunger is small the liquid has to be drawn continually from the reservoir without losing the pressure, and this is effected by the judicious manipulation of these valves (*v* and *v'*), the indicator being cut off and the reservoir connected when the plunger is being withdrawn and the reservoir cut off, and indicator connected when the plunger is being screwed in. A certain amount of liquid runs to waste from the safety valve when the desired pressure is obtained. The reservoir should be kept covered while in use to prevent dust getting into the liquid.

Care should be taken not to shake the instrument while the pressure is on, as it is liable to make the release act prematurely, and so vitiate the results.

There are several leather joints and packings which require attention; spare leathers are issued in a small tin box in the case together with the necessary spanners.

"Gauge, Dead Weight Testing, Mark II."

This has the body of the Mark I gauge, with a piston with packing similar to the Indicator, Mark II, but no gland. The area of the piston being enlarged from Mark I the motion is controlled by a lever to which the weights are hung.

The manipulation is the same as Mark I but there is no escape of liquid. The liquid to be used is the same as that employed in the cylinders of the H.P. Mountings. Special instructions are issued with the gauge (as to packing the piston, etc.), or with the fittings when issued for the conversion of Mark I.

* It should be noted that the bed plate, &c., (*e*) for the weights counts for 200 lb. (per square inch) in addition to the weights applied.

INSTRUCTIONS*† FOR THE ERECTION, WORKING, AND PRESERVATION OF HYDRO-PNEUMATIC MOUNTINGS.

Erection and Working.

Before the erection of the mounting is commenced, the following points must be attended to:—

- I. The racer should be perfectly level.
 - II. The roller paths (upper and lower), teeth of traversing rack, underside of clip ring and rollers should be quite clean, and free from burrs.
 - III. It should be seen that the roller ring has not been bent.
- The rollers and axles must be oiled, placed in the roller ring, and the ring given two or three revolutions on the roller path before putting on the mounting, to ascertain whether it runs truly, and that every roller bears continually. Two men should be able to move it freely.

The roller path on the underside of the mounting having been cleaned, oiled, and any burrs removed, the mounting should be lifted into position.

The traversing gear should next be attached, and one or two revolutions made to see that the mounting traverses freely. The truth of the racer may be tested here by a spirit level placed on any part of the mounting. As the mounting is revolved the bubble should remain stationary. The brackets for the pillars supporting the shield, and the front and rear holding down clips having been added, another revolution should be made to ascertain that the clips do not bind on the clip ring. The chequered foot plates should then be placed in position, and the lever handle of the raising valve keyed on its shaft. The cylinder is issued charged with liquid of the nature laid down in the List of Changes, § 5346, which is—

Methylated spirits	..	..	..	..	7 gallons.
Distilled water	..	..	..	..	3½ "
Mineral oil	..	..	..	..	4 "
Carbonate of soda	..	..	..	..	250 grains

and no other than the authorised liquid should be employed.

The following quantity of the liquid will be required, viz. :—

6 inch Mark I	..	..	..	..	about 14 gallons.
6 " " II, II*	..	..	..	..	12½ "
6 " " III and IV	..	..	..	..	26 "

Before filling, attach the indicator connection to the filling cock on the cylinder, and fix the indicator in its place, taking care that it is cut off by screwing up the valve of the connection, as otherwise the indicator may be injured by the pumping. It should stand within 15° of the vertical. Attach the copper pipe to the connection.

To fill the cylinder, (1.) Open the inlet at the connection, the raising valve, and the plug at top of cylinder, close the water level cock and

* See Special Army Order, dated 15th September, 1890.

† It must be understood that portions of these Instructions are not applicable to the Mark I mounting which is peculiar in many points.

pump liquid till it flows out at the top plug.* (2.) Close the top plug and raising valve, and pump liquid till it blows out in a spray from the water-level cock—which should be opened every now and then to ascertain whether the liquid has risen sufficiently. (3.) Change the pump to air, and pump air till the required pressure is shown on the indicator. The pumping should be stopped while the indicator is open to the pressure.

The working pressures (in pounds per square inch) of the different natures are as follows:—

6 inch Mark I ..	..	Gun { 570 }	Gun { 1,350 }
6 " " II to IV ..	..	up { 590 }	down { 1,250 }

For taking these pressures the elevator is "up" when it will rise no further with the raising valve open. Care should be taken not to allow the stops on the ram and cylinder (inside) to come into contact with force, or they may be burred and the subsequent recoils and elevations affected. The raising valve should therefore be cut off gradually as the ram nears the end of its stroke; this is shown by the arrow heads on elevator and bracket.

In the "up" position two (pencil) marks should be made on the ram, one level with the top of the gland, and the other at a distance from it as follows:—

6 inch mounting II, II* ..	..	..	..	35 inches.
6 " " III and IV ..	..	..	..	36 "

The upper mark will show the "down" position, and should be used as the datum for measuring the recoils so long as the gland is undisturbed. The elevator should not be let up with the full pressure behind it unless the gun is mounted, as it cannot be pumped down without straining the pump.

It is advisable to adjust the cut-off chain before mounting the gun, though it can be done at any time, and it is adjusted before issue. It should be sufficiently slack to allow the elevator to come fully "up," but without much jerk. The completing of the closing of the valve should be done by hand before pumping down or firing.

Pump down to the buffer stops, and secure the elevator by the holding down links before mounting the gun.

The gun may now be mounted, the elevating rods fixed in position, and the shield put on.

Particular care must be taken that the elevating arcs and pinions are put together correctly, as otherwise damage will occur. The distance between the centre of the trunnion of the crosshead and the centre of the pin of the elevating arc must be the same on both sides. The correct position of the elevating arcs and pinions for gearing together is indicated by scribed lines on the elevating shaft pinions and arcs, and the two pinions are stamped "Right" and "Left" in addition; the lines on either side should coincide in one position.

The degrees marked on the arc guides for quadrant elevation, are graduated so as to be correct for the "up" position, and should be checked at zero and maximum elevation and depression with a long base clinometer on the quadrant plane of the gun. The graduations are only correct when the elevator is fully "up," and the gun should never be fired unless it is so. To ensure this, the cut-off chain should

* NOTE.—In pumping liquid with the "Pump, air, double," the pump cisterns must be kept full, and the valve for liquid opened; the strokes must be slow and steady, otherwise air may also be drawn in. In pumping air the liquid valve is closed, and the strokes should be quick and jerky.

be sufficiently slack to allow a *slight* sound of contact between the stops in the cylinder to be audible to the No. at the raising lever.

The friction cone of the "equalising" gear should be tightened just sufficiently to prevent the elevating arcs running down of themselves when the gun is up. This will be arrived at by trial. The cone or plates of the elevating gear should be tightened if there is *much* slip of the elevating arc on firing. A slip of 3 or 4 inches of the arc should be allowed. Where the arrangement consists of alternate plates, care must be taken in putting them together that steel does not come against steel, and that the faces of the plates are free from burrs, &c.

Before raising the gun, clear away any covering plates from the shield. For the first time the gun should be put up slowly and carefully, and the cut off gear readjusted for length if necessary. It is always necessary to make sure of the closing before firing, by pulling over the lever by hand when the gun is up.

The liquid of the cylinder while in the air chambers becomes aerated to a certain extent, and when it passes into the inner cylinder the air is given off and collects at the top. This should be freed by loosening the plug on top of cylinder every now and then during the firing, otherwise the recoil may become excessive. The presence of too much air in the inner cylinder may be recognised by the ram "cushioning" at the end of its stroke, instead of coming to a dead stand.

In using the lowering pump, the pump handle (which is suspended from the shield when out of use) is put into working position and pinned there. Four or more men are required. Care should be taken to see that the gun commences to descend as soon as pumping begins, as it sometimes happens that the gun remains up, owing to friction in the ram gland while the pump is drawing the supporting liquid from under the ram, in which case the gun suddenly falls with violence, and damage is done. If, therefore, the gun does not fall at each stroke, it should be hauled back with tackle, pumping meanwhile being continued. In those mountings which have the suction pipes of the lowering pump entering the top of the cylinder, the pump will not as a rule begin to act until the top plug has been opened sufficiently to release any air at the top of the cylinder. This plug should not be unscrewed too far, or it may blow out and let down the gun. When the pumping down is finished, the pump handle should be removed.

Pumping down is generally made easier by attaching ropes to the handle on either side, on which the numbers may pull, instead of working direct on the handle.

If any leak is discovered, it should be dealt with before the gun is fired as described in the instructions for "Care and Preservation." If no leak is observable the firing may commence.

After first erecting, the firing must commence with a $\frac{1}{2}$ charge (with projectile), the recoil on the ram being carefully noted.

The recoils, measured on the ram, should not exceed:—

6-inch	II, II*	$\left\{ \begin{array}{l} \frac{1}{2} \text{ charge} \\ \text{full "} \end{array} \right.$	..	..	..	20 inches.
			..	..	..	35 "
6	III and IV	$\left\{ \begin{array}{l} \frac{1}{2} \text{ charge} \\ \text{full "} \end{array} \right.$	..	..	..	23 "
			..	..	..	36 "

If the recoil appears too great with the smaller charges, the valve must be adjusted as described below. As a rule the recoil with full charge may be short of the amount shown above, and care must be taken that the elevator does not come hard down upon the buffers when

recoiling, as there is danger of the gun fouling the crosshead or front transom of the elevator. Different marks of gun have different outlines; in mounting the gun for the first time, therefore, the clearances there should be looked to. The mountings are designed to bring the gun (with full recoil) to a constant elevation which is unaffected by the position of the elevating arcs, and the height of the buffers is intended to be so regulated as to give this position; but in practice these conditions are not always attainable, and the buffers should not be looked to as a guide. The "down" position as defined above by measurements on the ram, is the proper outside limit of recoil, and it should bring the elevating rods to their "dead centre." But even this condition is not always attained, and it should be borne in mind that it is the *worst* position of the elevating arcs when the gun is "down" that must be looked to in checking the clearances.

The position of the elevating band on the gun is of importance in connection with this (and also with reference to the accuracy of the graduations on the arc), and this position should be checked. The distance of the centre of the pivots from the centres of the trunnions should be as follows:—

	Perpendicular to Gun axis.	Parallel to Gun axis.
6-inch Mark II and IV mounting	11.28 inches	47 inches

Care and Preservation.

I. Adjustment of Recoil Valve. (Plate XXVI, Fig. 1.)

When the recoil obtained is not satisfactory, it is adjusted by altering the play of the recoil valve.

No permanent alteration should be made in the pressure laid down, which should always be worked to, but care should be taken that the pressure indicator is giving the correct record. This can be tested by the dead-weight test gauge supplied. In case of emergency extra pressure may be pumped in to check a tendency to excessive recoil, should such develop itself, and it is desirable to continue firing, but steps must be taken on the first opportunity to enable the service pressure to be resorted to. Loss of liquid will affect the recoil, and the liquid level must always be maintained. No definite effect in checking the recoil need be expected by any change of pressure under 100 lb. per square inch.

The recoil valve is situated inside the cylinder at the bottom, and to get at it the pressure must be let out at the filling plug or water level cock, and the bottom centre plug removed, which bares the head of the valve.

It is not necessary to remove the valve itself, except to renew the leather, or clear it of grit in case of a leak.

N.B.—The valve is set before the mounting is issued. *It should not be altered unless absolutely necessary.* When once adjusted for a particular charge, mark of gun, and nature of liquid, any continuance of abnormal recoils will probably be due to incorrect air pressure, and the accuracy of the indicator or the liquid level must be suspected first; at the same time an alteration may have taken place in the condition of the valve, necessitating an altered setting; before an alteration is made under these circumstances, the valve should be carefully examined, and anything calling for remark reported.

To adjust the valve (Fig. I), unscrew the stop nut (c), and the keep screw (d), turn the nut (b) until the keep screw comes opposite to the next slot in the spindle, and screw in the keep screw and stop nut again. Detailed information as to the difference made in recoil is stamped on each valve, together with the amount of the normal lift of the valve with which it is issued. This is necessary as a datum, since the adjusting nut can be turned round till it comes off. If it becomes necessary to remove this nut, the opening allowed to the valve after resetting should be measured. The actual amount of lift given is best measured by filing down a slip of metal till it fits the gap left between b and a where the coils of the spring give access, and then measuring the thickness of the slip.

After any alteration or adjustment of the recoil valve, the firing must commence with a $\frac{1}{2}$ charge, as stated above.

II. Adjustment of raising Valve and repacking its Gland.

(Plate XXVI, Fig. II.)

The gland of the spindle of the raising valve can be repacked without blowing out the compressed air from the recoil cylinder. If, however, there is a leak from the outer chamber to the inner through the raising valve itself, the pressure must be let out before the valve spindle (a) or its seating can be looked to.

To repack the gland, fasten the elevator down by the clips, and take off the nut (e) on the end of the valve spindle. Remove the stop nut from the end of the rack (f), pull out the rack and remove the bracket (g) and toothed wheel (d) from the valve spindle. The gland nut (c) can now be unscrewed, and the gland repacked, care being taken not to disturb the gland box unless for the purpose of replacing the leather packing (i), when the pressure must be let out, and the gland box screwed up again before the packing of the gland commences. In doing this care should be taken not to use too much force, as the gland box is rather weak. In replacing the gland nut (c) it should not be more than a quarter of an inch from "home."

Replace the toothed pinion, bracket, and nut; pinch the top of the pinion round from left to right until it can be moved no longer (taking care that it is not bearing against the gland nut), which will show that the valve is bearing on its seating; then pinch it back 38 teeth from the right to left, drop in the rack, and screw in the stop at the end of it; connect up the link in the cut off shaft to the top of rack. Replace the cover of the bracket, release the holding down clips of the elevator, and let the gun rise carefully. When the gun is "up" readjust the cut-off chain.

III. Leakage.

Leakage may be internal or external; if the former, it will probably show itself in a tendency of the gun to rise without opening the raising valve; if external, a dripping will generally betray its whereabouts.

Internal leaks may occur at (1) the seat of raising valve, (2) the recoil valve (generally from grit), (3) the leather joint of recoil valve.

If there is loss of pressure with no sign of dripping, the most probable place is the water level cock; but the leak may be into the ram at the bottom plug. The gun must be skidded up to examine

this, and the ram withdrawn and examined to ascertain if it contains water. This leak will only occur during firing, or when the weight of the gun is on the ram.

If it is necessary to renew the leather joint of a recoil valve or bottom plug, or examine a recoil valve, the pressure must be let out. In order not to waste any liquid in doing this, disconnect the nozzle of the pipe leading into the steel plug in the bottom of the cylinder, when most of the liquid can be caught in pails, then carefully remove the centre bottom plug, putting a pail under it to catch the remaining liquid.

Recoil Ram Gland.—If any considerable leakage occurs at the top of the cylinder, it should be stopped at once—if allowed to continue the recoils will soon become too great from loss of liquid. When the glands are in proper working order there should be no leak at all. By noting where the liquid issues, it will be known whether to screw down the outer or the inner gland. Too much force cannot be applied on the inner gland. Lengthening levers are required on the spanners, and if the spanners are found too weak they should be returned and fresh ones demanded. But in screwing down the inner gland it should not be driven lower than to bring its slots level with the outer gland; if it will not hold the pressure at this, it must be repacked with an extra layer of packing.

This packing, when in good condition, is sufficient of itself to prevent escape past the ram without the assistance of the U leather below it, and it is comparatively easily renewed. But if it becomes necessary to renew either of the leathers the ram must be detached from the crosshead.

Before removing any of the glands the gun must be raised and *skidded up*. If only the inner gland is to be unscrewed, the skidding should not be omitted, as the leather may fail to hold the pressure. The safest plan is to place suitable skidding across the opening of the shield, and pump the gun on to it. Another method, and one attended with less exposure, is to strut the cheeks of the elevator with skids placed against the buffer brackets, but this must be undertaken with every precaution to prevent the skids slipping.

When it is necessary to detach the ram from the crosshead, secure the cylinder by lashing to prevent it swinging when free (or the pumping gear, &c., will be damaged), and remove the nut on top of the crosshead. In the 6-inch Marks I and II, the cylinder is top heavy; in the 6-inch Marks III and IV, the weight is below the trunnions; arrangements must be made accordingly.

When the nut is off, and the weight of the cylinder properly taken by the lashing, &c., the ram can be pumped down by the lowering pump. When it is clear of the crosshead the glands can be removed and the leathers replaced from store. Great care should be taken in putting in a U leather to see that *the edges enter properly without being damaged*. After replacing all the glands and packings, open the raising valve gently, and the ram should then enter the crosshead again, when it may be secured by the nut. Allow the gun to rise, and remove the skidding.

The rope packing is the Service "hydraulic;"* it is woven square in section, with rubber core, and supplied by length. For use, it is cut into lengths so as to form rings (with the ends butting) which will just

* Asbestos packing should not be used, it is too friable.

enter the gland box. Not less than three are required to form a packing, which are inserted one above the other so as to break joint. The packing should be well greased with hot tallow before use.

If from remaining long in store the U leathers become at all shrunk, they should be placed in luke warm water to expand them before being put into the mounting.

As regards leakage at the ram gland, it should be observed that this should only occur while the gun is in motion, or with the weight resting on the ram. If it happens *continuously* while the gun is resting on the buffers, it will either be because the raising valve does not close, or because the recoil valve leaks. If opening the top plug or forcing over the lever of the raising valve does not stop the leak at the gland, the fault may be with the recoil valve; in either case there will generally be a tendency for the gun to rise, and tightening up the ram gland above will of course not stop the internal leak, which should be seen to.

When the recoil and raising valves are working properly, the best way to test the packing of the ram gland is to fasten the gun down by the holding down clips, and open the raising valve, when any escape will become apparent. The same test applies to the air plug in top of cylinder, which before firing should be screwed home, and be air-tight.

Without these precautions an escape of air at the top of the cylinder during firing is likely to be missed, and the pressure be lost unawares.

The lowering pump has a gland at each end, and a piston with packing. To pack the piston, the parallel link must be disconnected, and the upper guide bracket of pump rod removed. To renew the leather of the upper gland, the upper end of the piston rod must be unscrewed; in doing this the rod should be held by the hexagon and the upper end turned, so that the piston may not be turned in the pump cylinder.

The three pump packings can be attended to without blowing the air out of the recoil cylinder, provided the gun is down on the buffers, as there is then no pressure in the pump, the weight of the gun being taken by the buffers, and not by the recoil ram. To make sure that the pressure is removed from the ram, open the air plug at the top of the cylinder. The pressure from the air chambers of the recoil cylinder tends to shut the delivery valves of the pump, so that pressure should not pass to the pump except as with the ram gland, but the fact that these valves themselves may leak should not be lost sight of. Any leak from the pump or its connecting pipes should carry liquid with it.

IV. General Directions.

The efficiency of the mounting depends to a large extent on preserving the leathers in good order. The cylinder should therefore be kept filled with the proper charge of liquid, and under the full working pressure, and the gun slightly raised so that the weight is taken by the ram and not by the buffers.

All spare leathers should be kept in store and rubbed occasionally with dubbing to prevent their becoming hard and brittle. The supply of spare leathers should never be allowed to run low.

The plugs and covers closing the air chambers of the cylinder and the recoil valve should be removed about once every six months, and the cylinder and valve cleaned thoroughly before they are replaced.

If the carriage is to be kept in store for some length of time, it is worth while to pump in a small quantity more liquid, so that it may cover the level cock. There is then less likelihood of escape.

To keep the training gear in working order, the most important point is to see that the lower roller path is kept perfectly clear of dirt and fragments. If it has been well cleaned when first erected, there is very little chance of anything falling on it after it is closed in, if ordinary care is taken whenever the foot plates are removed.

The axles of the rollers and the bearings of the shafts of the rest of the gear will require periodical cleaning and lubricating, in the manner laid down in Army Form G 907.

The training and elevating gears are to be taken to pieces every six months by the Ordnance Artificers.

The elevating gear should be tried to see that the equalising friction brake is working properly, which it will not do if oil gets on the drum. The friction cones or plates should be *slightly* oiled to prevent scoring. The gun trunnion bearings should be well oiled.

The parts left bright at issue should be kept greased and not painted.

The positions of the oil holes are:—

Elevator trunnion	..	..	..	..	..	2
Crosshead	..	..	..	..	..	2
Cylinder	..	..	..	..	..	2
Bearings of elevating shaft, 1st motion	..	..	..	..	..	1
" " " " 2nd "	..	..	..	..	..	2
" " shaft raising valve	..	..	..	..	..	2
Bearing shaft, lowering pump, 1st motion	..	..	..	..	..	2
" " " " 2nd "	..	..	..	..	..	2
Brackets training gear (2)	..	..	..	..	..	6
Connecting rods (2)	..	..	..	..	..	2
Roller axles, two in each.						

The positions of the leather washers forming joints are:—

Outer gland	..	..	..	..	..	1
Raising valve	..	..	..	..	..	1
Air plug	..	..	..	..	..	1
Lowering pumps	..	..	..	..	..	5
" " connecting pipes	..	..	..	..	..	2 each
Filling cock	..	..	..	..	..	1
Bottom plugs	..	..	..	..	..	1 each
Recoil valves	..	..	..	..	..	1

The positions of hemp "hydraulic" packing and their sizes are:—

Lowering pump	..	..	2	size $\frac{3}{4}$ -inch square
Raising valve	..	..	1	" $\frac{3}{8}$ " "
Ram gland, 6-inch	..	..	1	" $\frac{5}{8}$ " "

All of these are in contact with liquid, except the air plug.

Metal joints required to hold pressure occur at:—

1. The water level cock.
2. The raising valve.
3. The recoil valves.
4. The filling cock.
5. Lowering pump valves.

"Carriage, Garrison, Barbette, B.L., 6-inch Mark I,
Slide L, B.L. 6-inch Barbette, Mark I."

Plates XXVII and XXVIII.

This mounting is constructed to fire "en barbette" from a sunken way, at angles varying from 15° elevation to 7° depression, and to be traversed and laid from the sunken way, or by the No. standing on the loading and sighting platform at the rear of the slide.

The carriage which stands on live rollers, is fitted with a frictional

elevating gear, a hydraulic buffer in tension, a shield, and front and gear clips. It consists of two steel double plate brackets, connected by front, and rear transoms, and a bottom plate. The elevating gear is actuated either by the hand wheel, R or R¹, by which motion is transmitted through bevel gearing on each end of the shaft, C¹, to a worm, worm wheel, and spindle pinion, C, which gears into the elevating arc, D, fixed to the elevating band, F, on the gun. The worm is keyed to the shaft, C¹, but is free to slide along it during recoil. The frictional arrangement is contained in a recess in the boss of the worm wheel; it consists of alternate rings of steel and gun metal, which are respectively arranged to revolve with the worm wheel and spindle pinion. These rings are pressed together by the nut J, and spring washer, so that the whole gear will revolve when the handwheel is turned, but the pressure is not sufficient to prevent the rings slipping on the shock of discharge, and thus easing the strain on firing. A yard scale graduated to suit the gun, and the height of the emplacement above sea level, when the gun is mounted, is fitted to the guard C, which covers the worm wheel; the metal pointer H, is fixed to the spindle pinion.

The hydraulic buffer A is of steel; it is fixed to the underside of the bottom plate along the centre, and fitted with a piston rod, B, which is attached to the front of the slide at K. A rotating valve fits on the piston rod in front of the piston and is free to revolve, but is kept in position by a nut screwed on to the piston rod. Ports are cut in the piston, differing from that in the valve, and as the carriage recoils the valve is turned by two ribs sliding in rifled grooves cut in the cylinder, thus gradually diminishing the opening until it is completely closed when the carriage is at extreme recoil. The velocity of the liquid through the port is the same at any position, thus causing an uniform pressure in the cylinder during recoil. A metal ring is let into the periphery of the piston to prevent abrasion.

The shield L, is of steel curved at the front and rear; it is supported by stays N, which are bolted to the side bracket of the carriage.

The slide is mounted on a live roller ring; it is fitted with traversing gear, retaining gear, loading and sighting platforms, and two front spring buffer stops. It consists of two steel side girders, connected by two transoms; plates are fixed to the underside of the slide for the attachment of the upper roller path, and holding down clips 1, to the front and rear, which hook under a rim on the racer. The traversing arc, O, is let into the floor of the work and a pointer is fixed to the rear of the slide by which the angle of traverse is indicated.

The traversing gear is fitted to the rear of the slide and is worked by either of the handwheels S or S'. These handwheels transmit motion through bevel wheels and spur gearing to a pinion P which gears into a forged steel rack bolted to the racer.

Retaining gear to hold the carriage in the loading position is fitted to the right side of the slide. It consists of a lever and tappet so arranged, that when the lever is raised, the tappet disengages from the stop and the carriage is free to run up.

The loading and sighting platform consists of a wrought-iron chequered plate supported by two side plates bolted to angle iron pieces on the sides of the slide; the platform is reached by the ladder U.

The live roller ring consists of a loose ring with projecting axles for the rollers, which are flanged and run upon the racer which is secured by bolts V and Plates V' to the work.

Brackets are fitted to the left of the slide to take the "Battery and
(7415) C 2

Key test and Firing" and from there permanent wires are led up to a bracket attached to the handrail. The tube wires for electric firing are attached to the binding screws on the handrail, but the firing key may be placed in the grooves of the battery or in the bracket of the handrail according to whether the firing No. stands in the sunken way or on the sighting platform. A loose contact piece is supplied with the handrail bracket, which must take the place vacated by the firing key whether in the battery or handrail bracket.

WEIGHTS, &c.

						Tons	cwt.	qrs.	lbs.
Mounting .. .. .	..	..	..	..	..	5	2	0	0
Roller path and racks .. .. .	..	..	..	..	..	1	19	0	0
Roller ring, rollers and pins .. .. .	..	..	..	..	..	0	10	3	0
Anchor plates and bolts .. .. .	..	..	..	..	..	0	17	1	0
Total ..						8	9	0	0

Height at axis of trunnion, carriage 36 inches, slide 20.25 inches.

Radius of racer, 3 feet 9 inches.

Quantity of oil for buffer about 11½ quarts.

MOUNTING THE SLIDE.

After seeing that the upper and lower roller paths are cleaned and oiled; remove the clip K from the front of the slide, and lower the latter carefully on to its place, guiding the pinion fairly into the training rack.

MOUNTING THE CARRIAGE.

Remove the front and rear clips from the carriage, and the elevating shaft from the slide, and lower the carriage gently on to the slide, then replace the carriage clips, and shaft and clip K, and draw the piston rod end into its socket in the front of the slide, screw on the nut, and put in the cottar pin.

"Carriage, Garrison, B.L., 6-inch, Vavasour Central
Pivot, Mark I."

Plate XXIX.

The mounting is constructed to give 15° elevation, and 15° depression; it is fitted with hydraulic buffers in tension which limit the recoil to 18 inches; frictional elevating gear; and traversing gear. It is mounted on a live roller ring to minimise the power required for traversing, and these rollers run on a racer, on the top of a large cast steel pivot plate by which the mounting is secured to the emplacement.

The carriage consists of two cast steel brackets A, each cast with a bore for the buffer cylinder; a trunnion bearing for the gun; and a grooved underside to form clips for securing it to the slide. Steel liners are fitted in the bore for the hydraulic buffers, which are connected at the front by an equalizing pipe. The piston rods, B, are secured to lugs on the slide by nuts; the piston is grooved in the centre to take a rotating valve, which is in two pieces to admit of its being bolted in position. Rifled grooves are cut in the liners, and ports of varying size in the piston and rotating valve; as the carriage recoils

the rotating valves are turned by the grooves until the ports are completely closed; the carriage is then at its full recoil. A metal ring is let into the periphery of the piston to prevent abrasion. The pitch of the rifled groove and the form of the ports are so arranged that the velocity of the liquid through the ports is the same at any position, thus causing an uniform pressure in the cylinder during recoil. The rear cap of each buffer is fitted with a controlling ram, which enters a hole (of slightly larger diameter than itself) bored in the piston rod to receive it; so that when the gun and carriage run up (automatically) after recoil, the rams entering the holes in the piston rods displace the liquid contained therein, and thus acting as hydraulic buffer, bring the gun and its carriage gently to rest.

The elevating gear is actuated by the handwheel U which transmits motion to the elevating arc X, through the worm wheel B', and pinion W. The elevating gear can be worked from two points, the wheel U being fixed on either of the shafts V' or V. In the former case motion from the shaft V' is communicated to the shaft V by means of two equal spur wheels contained in the casing F.

In neither case does the wheel U move during recoil as the worm A' slides along a featherway in the shaft V.

The frictional arrangement is contained in a recess in the boss of the worm wheel; it consists of alternate rings of steel and gun metal, which are respectively arranged to revolve with the worm wheel, and spindle pinion. These rings are pressed together by the nut and spring washer Y', so that the whole gear will revolve when the handwheel is turned; but the pressure is not sufficient to prevent a slight slip on the shock of discharge, thus easing the strain on the gear when firing. At the rear of the elevating arc is fitted a metal plate on which a yard scale is graduated to suit the gun and the height of the emplacement above sea level when the gun is mounted. A metal reader is bolted to the side of the carriage.

The slide consists of two cast steel brackets connected by an inner shield at the front, a transom at the rear, and a bottom plate, to which is attached in two segments the path for the live rollers S. The rollers revolve on manganese bronze axles projecting from a loose ring.

Traversing is effected by the handwheel P, which transmits motion through spur wheels to the shaft J, which passes through bearings on each side of the slide. On the centre of this shaft the worm H is keyed, which engages with the worm wheel K, resting on the bottom plate of the slide, and keyed to the pivot pin, the top end of which passes through a bushed hole in the bottom plate, and the lower end is firmly fixed to the cast steel pivot plate.

A friction clamp Q, is fitted to each side of the slide to clamp the spur wheels when the requisite traverse is obtained.

A retaining pawl is fitted to each side of the slide to hold the carriage in the housing position; when it is required to disengage the pawl from the stop to run the carriage up, the keep pin is withdrawn, and the pawl forced down by a tommy.

Front and rear clips T, of cast steel are fitted to the slide formed to hook under a rim on the pivot plate to prevent the mounting from lifting when the gun is fired.

The circular shield is bolted to the inner shield, and supported by stays bolted to the side girders of the slide; the central part of the roof of the shield is hinged so that it may be brought into a horizontal position to admit of a more extended view if required.

A double traversing arc is laid in the floor of the work, and the degrees are indicated by two pointers bolted to the slide.

Height at axis of trunnion	..	..	..	42 $\frac{1}{2}$ inches
Radius of racers..	..	..	..	27 "
Quantity of oil for buffers	..	..	about	13 $\frac{1}{2}$ quarts
Weight	{ Mounting	..	5 tons 11 cwt. 1 qr. 0 lbs.	
	{ Pivot plate..	..	0 " 15 " 3 " 9 "	
<hr/>				
6 tons 7 cwt. 0 qr. 9 lbs.				

INSTRUCTIONS FOR CARE AND PRESERVATION OF CARRIAGE AND SLIDE B.L. 6-INCH BARBETTE, MARK I, CARRIAGE B.L. 6-INCH, AND VAVASSEUR CENTRAL PIVOT, MARK I.

(Extract from Equipment Regulations.)

If the mounting is not frequently used, the movable parts of the elevating, and other gears will be removed and placed in store, where the bright parts of the iron work will be coated with "Field's grease No. 3" to preserve them from rust.

These parts will be thoroughly cleaned and placed in position at least once in three months to see that they are in proper working order. All other gears should be worked once a week to ensure their being in a working condition.

If the paint is rubbed off any part of the mounting, the place should be patched over as soon as possible to prevent rust.

A thorough cleaning and lubricating of all standing working parts must take place once a month. In this cleaning all clotted grease must be removed where visible, by scraping, and the parts wiped with an oily rag. Where the mounting is much exposed and liable to accumulate dust or sand, it should not be left with much grease or oil upon it, but only sufficient to prevent rust, for which a very slight film will suffice.

Whenever and wherever fresh lubricant is applied, the old should first be wiped or scraped off, and the parts well worked to distribute the fresh lubricant before leaving them.

It has been found—especially in exposed positions—that a hard glassy cake of oil and sand, &c., will sometimes form between the carriage and slide which is likely to escape observation, being of a semi-transparent nature, and which induces violent recoils from the very slippery surface it presents. Such a skin has to be hammered off; its formation is best guarded against by leaving as little oil on the sliding surfaces as possible when not in use.

Before firing or drill care should be taken that all nuts and screws are properly tightened up; that all working parts are in proper gear; and that all friction plates are accurately adjusted, and are not jammed.

Particular attention should be paid to the clip plates, the bolts of which tend to stretch and throw undue strain on the guide plates.

If a nut or screw be removed it should be slightly oiled before being replaced, and a few turns given to it by hand before using the spanner, to prevent damage by the threads crossing. A burr on the threads of a screw will prevent it being screwed home; the burr can be easily removed by means of a file. A hammer should never be used to tighten up screws or nuts.

Particular attention will be observed when removing or adjusting

any gear not to indent or damage the component parts by rough usage; a hammer should never be used unless with a piece of wood or brass to transmit the blow.

In lubricating, the lubricating holes will be cleaned out with a wire and filled with oil, care being taken to replace the small screws, the heads of which must be kept bright so as to be readily seen.

A list of the oil holes in the mounting stating their position and how access is obtained to them, is to be hung up in each emplacement and none must be neglected.

These lists can be obtained on demand.

After filling the oil holes, the parts should be worked backwards and forwards until the oil shows on the shafting, fresh applications of oil being made if necessary.

The axles of the live rollers should be removed, cleaned, and lubricated. The axles can be taken out one by one.

The teeth of all pinions, and toothed wheels, should be greased.

The hydraulic buffers should be carefully examined before firing or drill, to see that the cylinders contain the requisite quantity of fluid marked on the inscription plates, that there is no leakage at the glands, and that the piston rods are properly connected.

If a buffer leaks at the gland and tightening up the latter does not stop the leak, the packing must be renewed.

The buffers will be kept filled and periodically examined.

The whole of the gear must be removed by Ordnance Artificers periodically, and all parts cleaned, keys adjusted, bolts and nuts tightened, lubricating holes thoroughly cleaned, the trunnion holes greased, and all parts properly lubricated, and any slight defect made good before reassembling the parts.

Whenever any parts are found broken, defective or deficient, which cannot be renewed by the artificer, fresh parts should be demanded at once. Any damage occurring at drill or practice, should be at once reported with a view to its being made good without delay.

The adjustment of the degree scale of index plates, graduated arcs, or elevation indicators, should also be checked. These should read at zero on the degree scale when the axis of the gun is horizontal. The horizontal position of the gun can be obtained by a spirit level resting on the quadrant plane prepared on the breech of the gun.

In all correspondence and reports relating to these carriages and slides, their exact natures, marks, and register numbers should be quoted.

PROJECTILES.

Plates XXX to XXXIII.

TABLE XXXV TO XXXVII.					
Nature.	Mark.	Material.	Bursting Charge.		Weight filled and fuze.
			P	F.G.	
Shells	Common	III Iron	6 lbs. 6 ozs.	1 lb. 0 ozs.	100 lbs.
		V Cast steel	7 " 13 "	1 " 4 "	
		VI " "	8 " 4 "	1 " 9 "	
	II Iron	—	7 "		
	III Forged steel	—	8 "		
	IV " "	—	10 1/2 "		
	V Cast steel	—	8 "		
	I Gunmetal	—	8 "		
Drill	III+ Chilled iron	weighted with sand			
	IV " "	—			
	V " "	—			
Shot	Palliser				
	Armour piercing	I Forged steel	{ weighted with small shot and sawdust.		

DESCRIPTION.

Common Shell.

Plate XXX.

The Mark III shell is cast to the figured dimensions. Rotation is given by means of a Vavasseur driving band 1.754 inch wide, pressed into a groove .67 inch from the base. It has two cannelures. The base of the shell is bored and screwed 14 threads per inch left hand for a metal plug, and countersunk about .16 inch in depth, so as to admit of a lead disc being hammered in over the head of the plug after the shell is filled. The shell is filled from the base, and the charge is contained in a serge or dowlas bag. The cast steel shell (Mark VI) is very similar to the iron one, but slightly longer, and the walls are thinner. The fuze hole socket is larger and stronger, and the base plug is larger and has a flange. It is screwed nine threads per inch left hand, and has no lead disc. This shell is also filled from the base, and the charge is contained in a silk cloth or dowlas bag.

Mark V shell differs from Mark VI chiefly in having thinner walls, and the base plug not flanged, but taking a lead disc of larger size than the iron shell.

*Shrapnel Shell.

Plate XXXI.

The Mark II cast-iron shell is cast to the figured dimensions. It has a solid base, and is fitted with a driving band the same as described for the common shell. The head and internal arrangements are similar in general construction to those of other service Shrapnel shell. The shell contains 255 mixed metal balls (14 to the pound), and takes a bursting charge of 7 oz. F.G.

The Mark III forged steel shell is very similar to the iron one, but about 1.5 inch longer, and the walls are only .5 inch thick instead of 1.1 inch. The Mark IV shell is slightly shorter and stronger. The head of the latter fits inside the walls of the body, which is lined with glazed board. The Mark III contains 700 mixed metal bullets (16 to the lb.), and has a bursting charge of 8 oz. F.G. The Mark IV contains 536 bullets (14 to the lb.), and takes a bursting charge of 10½ oz. F.G.

Mark V shell is of cast steel: it contains 518 mixed metal balls 14 per lb.; the bursting charge is the same as for Mark III.

Palliser Shot.

Plate XXXII.

The Mark III shot, originally issued as a shell, is cast to the figured dimensions. It is fitted with a narrow Vavasseur driving band bevelled off towards the head. The base plug is countersunk and secured by the lead disc. Shot of this nature are weighted up to 100 lb. with sand, and marked W. The Mark IV shot is similar, but has only a small core closed by a soft iron plug resting on a soft iron bush and firmly secured by being run in with molten lead. It is fitted with a broad driving band with two cannelures, as in the case of common and Shrapnel shell.

Mark V is of almost the same external dimensions as Mark IV, but the core is filled with soft cast iron, and there is no plug in the base.

* Iron and forged steel will be superseded by cast steel in the future manufacture of these shell.

Shot, Armour-Piercing.

Plate XXXIII.

This is of forged steel, resembling externally the Palliser shot. It has a core (the size of which is left to the manufacturer) in order that a burster may be inserted, should one be hereafter decided on, but at present the shot must be weighted up with small shot and saw-dust. The base is closed by a screw plug. The weight of the shot is 100 lb. \pm 2 lb., and it is calculated to pierce 9 inches of compound armour at 100 yards range.

Shot Paper.

A papier-mâché shot for use from guns which cannot fire service projectiles in time of peace is being prepared. It consists of a pressed paper cylinder painted black, and having a filling hole in the base, closed with a plug. When required for use, the shot is brought up to service weight by filling with a proportion of small shot and sawdust.

Drill Shell.

This is made of gun-metal. The base, which screws into the body, is recessed, and a hole is bored in the centre and screwed to receive an eye-bolt, to which is spliced 9 feet 8 inches of tarred rope by which the shell is withdrawn from the gun. At the junction of the body with the base, an annular recess is formed in which fits a rope grummet, which prevents the shell jamming in the gun.

No more of the gun-metal shell will be made; a cast-iron shell with copper bands will be provided similar to the 12-pr. drill shell.

INSTRUCTIONS FOR FILLING SHELL.

Common.

Weigh out the bursting charge in several portions of about 2 lb. P. and 8 oz. F.G.

Place the shell upon its point, which may be inserted in a block of wood hollowed out for the purpose, or in any other convenient place; pass the "holder shell, B.L., 6-inch, with spanner attached," over the base, and screw up the bolt; then hold the handles firmly, while another man unscrews the base plug. Now drop in three "bags, primer, filled, seven drams." Place the brass filling-rod inside the bag and insert it in the shell, taking care not to push the rod through the bag, a portion being kept outside, as the whole bag must not be allowed to slip into the shell during the operation of filling; then withdraw the rod. Drop one portion of P into the shell pebble by pebble, then insert the funnel and pour in one portion of F.G. Repeat this operation till the shell is completely filled. When the shell is quite full tie the neck of the bag with twine, close to the plug-hole, cut off the superfluous choke, push the neck of the bag well down; then screw in the plug, taking care that the plug-hole is clean and the plug lubricated, and in the case of Marks III and V insert the lead disc, and hammer it into its place.

Shrapnel.

Remove the plug from the fuze-hole, and after seeing that it is clear of any dirt, &c., insert the leather funnel and pour in the bursting charge, which has been previously weighed out or measured. This

must be done gradually or the tube is liable to become choked. The shell should be tapped on the side with a wooden mallet until the whole of the bursting charge has passed down the tube, care being taken that none of the powder is left at the bottom of the socket. Drop in the primer Shrapnel shell, Mark III, and, by means of the "driver, screw, Shrapnel, large," screw it tightly into the tube, and then screw in the fuze or plug as may be required.

FIXING PLUGS AND FUZES, AND SECURING SHELLS.

When plugs or metal fuzes are screwed into shells they will be lubricated with Price's composite grease.

Filled common shells have the projection on the "disc, base plug" inserted in the hole in the base plug, and the disc hammered flat in the recess provided for it, and painted over with black paint. When hammering in the lead disc care should be taken to commence at the centre, working outwards.

Empty projectiles fitted with plugs and kept in exposed situations where the plugs are liable to become set fast by corrosion from the action of salt water or otherwise, should have them unscrewed once at least every six months, and the threads cleaned and re-lubricated as above.

Instances have occurred in which fuze-hole plugs of common shells have been so jammed in as to be immovable, in consequence of using the "Wrench, base plug." The "Key, fuze and plug, G.S.," the "Key, plug, G.S.," or the "Key, fuze, universal," are the only implements which should be used for screwing in the G.S. plug.

DISTINGUISHING MARKS.

All Shrapnel shell will be painted with a red tip 1 inch deep.

All steel shot or shell will have a white band $\frac{1}{2}$ inch wide painted round the head 1 inch from top; in the case of Shrapnel this white band will be immediately below the red tip. C.S. will be stamped on the base of cast steel, and F.S. on the base of forged steel projectiles.

All filled shell will have a red band $\frac{1}{2}$ inch wide painted round the head $1\frac{1}{2}$ inch from top; in the case of steel shell this band will be immediately below the white band, and in the case of cast iron Shrapnel it will be $\frac{1}{2}$ inch below the red tip. They will be marked with the date of filling, and also the monogram of the station, except when filled by the Royal Artillery.

Filled shell will be marked with the word "Bag" if a bag is used, and with a red disc 1 inch diameter if shalloon primers have been inserted, and with the letter P if filled with P and F.G.

Palliser shot (formerly shell) which have been weighted up with sand will have the letter "W" stencilled in white on the head, and also stamped on the base plug.

Projectiles which are to be used for practice only will be marked with a yellow band, $\frac{1}{2}$ inch wide, round the body.

Shells which have been emptied will be marked on the head with the letter E in red paint, and the monogram denoting the station.

STORAGE OF FILLED SHELL IN CHARGE OF THE ROYAL ARTILLERY.

Filled shell will be stored on their bases. In exceptional cases, however, where it is desirable to utilize existing accommodation which will not admit of the shells being so stored, they should be piled as may be found most convenient, a board being placed for the bottom

layer to rest on just in front of the driving band, and each layer pointing in the opposite direction to the one below, to prevent injury to the driving bands.

EXAMINATION AND EMPTYING OF FILLED SHELL. Common.

Remove, if present, the lead disc from the base plug by means of a bronze hammer and chisel, and unscrew the base plug by means of the "Wrench, base plug." Draw out and untie the neck of the bag, using the "Hook, G.S., wads." Examine the powder; if it is found to be serviceable, tie up the neck of the bag again and proceed as in the instructions for filling. If the powder is caked or deteriorated from the effect of damp the shell must be emptied.

To empty the shell invert it over a convenient receptacle and allow as much of the powder to run out as possible. No metal rod or wire is to be used, but, if necessary, a wooden rod, which may be made locally, may be used to prevent the powder from jamming. It should not, however, be used to loosen the dry powder if it be caked into a hard mass. If all the powder cannot be thus extracted fill up the shell with boiling water and allow it to stand for five minutes. The water will then be poured off and the shell filled up again with boiling water. After standing 15 minutes more the contents may be stirred and loosened with the wooden rod, or, if necessary, with a copper scraper, but the latter is not to be used until 15 minutes have elapsed since the second addition of boiling water, and, when it is being used to loosen the powder, the shell is to be in an upright position and filled with water. The scraper is never to be applied to the dry powder. After loosening the powder invert the shell and empty out the water and as much powder as possible, using the wooden rod to assist in extracting the loose powder. If the whole of the powder cannot be extracted reverse the shell again, refill it with boiling water and repeat the above operations. The shell will then be stood so as to allow the water to drain off, and finally will be wiped out with a piece of waste tied to a rod, and left to dry.

Shrapnel.

Remove the fuze hole plug, unscrew the primer with the "driver, screw, Shrapnel, large, Mark III," lift out the primer with the "pincers, Shrapnel, primer;" turn the shell nose downwards, and if the powder charge flows out and is serviceable, refill and replace primer and plug; the shell should be well shaken if the powder does not come out quite freely, as a portion of the powder may be jammed in the tube. If the whole of the bursting charge cannot be extracted in this manner, which can be ascertained by weighing the powder, fill the shell with boiling water and proceed as in the instructions for common shell, using a copper or brass wire instead of a scraper. On no account is the wire to be used in a dry shell.

Shrapnel shell, which have been washed out, are not to be filled again, but will have a yellow band, half an inch wide, painted round the body and will be plugged and used for practice.

AUGMENTING STRIPS.

Augmenting strips are intended to be used with B.L. projectiles in cases when the rifling of the gun has, owing to firing, become so worn that the gun ceases to properly rotate its projectiles,

The strips are of copper of even section throughout, and grooved on one side. The lengths of the strips vary with the calibre, and they are marked for the nature of gun with which they are intended to be used.

Method of Insertion.

By means of the special chisel (supplied for the purpose), and a hammer, V-shaped grooves are cut in the bottom angles of the upper cannellure of the driving band, all round the cannellure; the augmenting strip is then inserted into the cannellure, grooved side of strip inwards, and lightly hammered until the tongues of metal formed by the groove in the augmenting strip dovetail with the undercuts in the cannellure.

Projectiles in future will have the cannellures of their driving bands undercut during manufacture. They will then be stamped U, and no preparation for the insertion of augmenting strips will be necessary.

When the gun is very much worn, and one strip is found insufficient to impart the proper rotation to the projectile, two augmenting strips may be used, the second being secured in the lower cannellure.

The number of rounds which may be fired from the 6-inch B.L. gun before augmenting strips must be used is, (probably) with the Mark II P gun, 438, and with the other Marks 395.

The effect of reduced charges as regards wear of bore may be reckoned as one quarter that of a full charge.

FUZES.

Plates XXXIV to XXXVIII.

Time:—Time and Concussion, Medium, No. 52; Time and Percussion, Middle, No. 54; or Sensitive Middle, No. 24.

Percussion:—Direct-Action I,* II, and III, No. 3.

The Direct Action and Middle Sensitive, are the latest approved fuzes.

Fuze, Time and Concussion, medium (Mark II).

Plate XXXIV.

The body of the fuze is made of soft metal, consisting of a mixture of lead and tin, with a small proportion of antimony. The other parts are made of gun-metal. They consist externally of two parts, which are packed separately, viz., the fuze proper, and the thimble by which it is ignited.

The fuze is fitted and screwed to suit the general service fuze-hole.

It is screwed into the fuze-hole of the shell, set, &c., by means of "Key, fuze, universal."

The arrangement for "time" is contained in the upper part of the fuze; the column or ring of fuze composition being in the body of the fuze, and a movable metal collar and clamping nut being fitted over it.

The exterior circumference of the body of the fuze is graduated in inches and tenths of an inch, and a small hole is bored in it for the reception of a projecting pin on the fuze key. The metal collar is marked with an arrow, which, when the fuze is being set, must be made to correspond with the desired mark on the graduated scale; and it is furnished on the top with two recesses into which the key fits for turning it. The clamping nut is cut with six faces, to suit the smaller hexagonal recess in the key.

The fuze is graduated to 5 inches, and when set to that length it burns (at rest) about 11.1 seconds.

Ignition of the fuze composition is effected by means of a "thimble," which consists of a percussion pellet, suspended in a metal screw plug, over a needle point in the centre of the fuze.

This thimble is carried separately from the fuze, and *must not* be screwed in until after the fuze has been inserted into the shell and adjusted, and at the moment of loading.

Great care should be taken after the thimble is inserted that the shell is not dropped, *particularly on its base*.

The "concussion" arrangement is contained in the lower part of the fuze. It consists of a white metal pellet, or hammer containing the detonating composition, and a pellet of pressed powder, and a metal guard. The guard is suspended by means of a brass ring, which passes round the pellet, resting on a band slightly enlarged in diameter, at the bottom of the pellet. The ring is divided so as to be free to expand. On the shock of discharge, the weight of the guard sets down the ring over the band on the pellet, and the guard is locked by the upper part of the pellet being expanded into an internal groove at the top of the guard.

If it be desired that the percussion arrangement alone should act, the arrow on the collar must be set midway between the zero point of the graduation and the extreme length of fuze composition. Great care must be taken that it is not set too near the zero, in order to avoid "prematures."

The method of fixing the fuze is as follows:—

- (a) The fuze, without the thimble, is tightly screwed into the fuze-hole by means of the "Key, fuze, universal," before the shell is brought to the gun.
- (b) The metal nut is unscrewed a little by hand or key, to loosen the metal collar, which is turned until the arrow head on it is opposite the desired mark on the scale.
- (c) The nut is now tightened to keep the collar in this position.
- (d) The thimble *must not* be screwed into the top of the fuze until the moment of loading.

Weight of fuze 15 oz. 1 dram.

Each fuze, without its thimble, is wrapped in paper, and packed in a tin box or cylinder, hermetically closed by a tin band.

The thimbles are also packed in tin cylinders, containing 20 each.

* "Time and Percussion, Middle, Mark I."

Plate XXXV.

The fuze is made of gunmetal, turned all over and screwed to suit G.S. fuze-hole; the interior is fitted with a steel needle, percussion pellet, retaining bolt, safety pellet and brass ball; the upper part of fuze is fitted with a composition ring having a stem for containing a lighting needle, suspended by a copper shearing wire .022 inch diameter; a dome is fitted over the composition ring and secured by a cap screwed on the stem of body of fuze. The bottom of fuze is closed with a screw plug of gunmetal, having a conical hole into which is inserted a powder pellet covered with a fine paper disc, a

* This fuze is obsolete for future manufacture.

shalloon disc and brass washer being spun over it. The fuze has two safety pins, one through the safety pellet, and one through the lighting needle, each having a loop of string attached.

These fuzes are screwed into the shell before being set by the "Key, fuze, universal," using the circular arm with the small projection on it, which fits into a hole in the body of the fuze. To set these to act for time only, loosen the nut with the "Key, fuze, universal," and turn round the composition ring, with which the dome will move also, until the required graduation on the ring is opposite the arrow-head on the body, and clamp the nut. At the moment of loading, withdraw the upper safety pin which will be found protruding from the composition ring. If the fuze is required to act as a percussion fuze only, take out the lower safety pin which will be found in the body of the fuze. If the fuze is to be set for double effect, set the time arrangement as above, and pull out both safety pins.

"Fuze, Time, Sensitive, Middle."

Plate XXXVI.

The fuze consists of the following parts:—

Body (*a*) with stem, lighting pellet (*b*), two retaining pellets (*cc*), two spiral springs (*dd*), needle (*e*), composition ring (*f*), dome (*g*), cap (*h*), two safety pins (*ii*), base plug (*k*), and axial magazine filled with M.G.¹ powder (*l*).

All the parts are made of gunmetal.

The composition ring is graduated on its periphery from 0 to 30 and reads to quarter units. An ψ is stamped on the ring to show the safety point, and when this coincides with the \uparrow on the body, the fuze is set at safety. The cap which screws on to the top of the stem, is made hexagonal to fit the "Key, fuze, universal."

The fuze is set by loosening the screw cap (*h*) on the top of the stem by means of the "Key, fuze, universal," and turning the dome and ring till the required graduation on the latter coincides with the arrow head on the body, then tighten the screw cap. The safety pins are withdrawn at the moment of loading. On discharge the centrifugal action causes the retaining pellets to fly out, releasing the lighting pellet, which flies out by centrifugal force against the needle, firing the detonator which ignites the powder in the pellet and axial magazine, this latter lighting the quick match in the composition ring.

"Direct-Action Fuze, Mark I*, II and III."

Plates XXXVII and XXXVIII.

The Mark II is made of gunmetal, turned all over and screwed below the head to suit G.S. fuze-hole; the interior is bored out at the lower end for the powder charge, and screwed to receive base plug; the upper part of fuze is charged with detonating composition, over which is a brass disc .005 inch thick, and the holes communicating with magazine filled with powder priming; the fuze is fitted with a steel needle passing through and secured in a copper suspending disc .032 inch thick. The lower part of the fuze is filled with pistol powder and covered with a disc of shalloon.

Mark III, Plate XXXVIII is practically identical with Mark II internally but differs externally in having no cap and being screwed from top to bottom. It is closed at the top with a left-handed screw plug,

instead of the cap as in Marks I* and II. This enables it to be screwed into the shell before issue for S.S.

Mark I* is essentially the same as Mark II, and is the pattern to which the Mark I have been converted.

These fuzes require no preparation except the removal of the metal cap of Marks I* and II or plug of Mark III. Marks I* and II are screwed firmly into the fuze-hole by means of the "Key, plug, G.S.," and Mark III by the "Key, fuze, universal." The caps of Marks I* and II are fastened on to the head of the fuze by two double bayonet joints, which enable the caps to be used either in fixing or unfixing the fuzes. The caps can be removed by bringing the centre of the bayonet joints in line with the studs on the head of the fuzes. The plug of Mark III has a left-handed screw thread. The cap or plug is not to be removed until just before entering the shell into the breech of the gun.

On striking any object the suspending disc is driven in and the needle is forced against the detonating composition, thereby exploding the fuze.

CHARGES.

Plates XXXIX and XL.

For Mark IV	42 lb. P ² , made up in $\frac{1}{2}$ charges.
and	45 lb. Prism ¹ Black, in $\frac{1}{2}$ charges, Mark II.
Mark V	48 lb. E.X.E. made up in $\frac{1}{4}$ charges.
For Mark VI	48 lb. E.X.E. made up in $\frac{1}{4}$ charges.
Saluting	7 lb. Blank

42 lb. P² was the first charge introduced, and an issue was made to Hong Kong for Mark V guns. For future manufacture 48 lb. E.X.E. will be the charge for Mark IV and VI guns, and 45 lb. Prism¹ Black for Mark V, but alternative charges may be used for the different Marks as shown above. Range tables will be found on pages 56 to 62.

N.B.—The Mark I cartridge, containing $22\frac{1}{2}$ lb. of Prism¹ Black, is suitable for the Mark IV and VI guns, but will not fit the chamber of the Mark V gun. Mark II cartridge, containing a similar weight of the same powder, is suitable for Marks IV, V, and VI guns. No more Mark I cartridges will be made.

NOTE.—Future supplies will be of E.X.E. only.

12 lb. Cartridge E.X.E.

Plate XXXIX.

The cartridge is made of No. 3 silk cloth, and is built up in 5 layers of 22 prisms each, and one of such convenient number, not less than 16, as will bring the total weight up to 12 lb. Should the top layer contain less than 16 prisms, one or more prisms will be taken from each complete layer to make up the requisite number.

$22\frac{1}{2}$ lb. Cartridge Prism¹ Black, Marks I and II.

Plate XL.

Both cartridges are made of No. 3 silk cloth with eight silk braids, and have a hole 2.5 inches in diameter, covered with silk and shalloon (the latter being removed before loading) in the top and bottom.

Mark I cartridge is built up in 12 layers, 11 of 21 prisms, and one of such number as will bring up the weight of the cartridge to $22\frac{1}{2}$ lb. As before mentioned this cartridge is unsuitable for Mark V gun, and no more will be made.

Mark II cartridge is built up in 13 layers, 12 layers of 19 prisms each, and one of such convenient number, not less than 14, as will bring the weight of the powder up to $22\frac{1}{2}$ lb. If the top layer contains less than 14 prisms, one or more prisms will be taken from each complete layer to make up the requisite number.

21 lb. Cartridge P.²

This cartridge is made of No. 2 class silk cloth. The bottom is made circular in form, and secured to the lower end with silk sewing; seven silk braids are threaded round the cartridge, each braid having a loop formed at one end, for the purpose of tightening up and making a firm cartridge.

The dimensions of the cartridge are as follows:—

Empty	length..	..	..	18.25 inches.
	width ..	..	..	11.2 "
Filled	length..	..	..	12.9 to 13.5 "
	diameter	..	..	7.5 "

7 lb. Saluting Cartridge.

This cartridge is used for saluting and exercise. It is made of No. 1 class of silk cloth. Its dimensions are:—

Empty	length..	..	..	13 inches.
	width ..	..	..	8.8 "
Filled	length..	..	..	7.3 to 7.8 "
	diameter	..	..	6.0 "

Drill Cartridge.

This cartridge is made of wood covered with raw hide and weighted up with iron or lead. It is identical in size, shape, and weight with 12 lb. E.X.E. cartridge. It is not suitable for use with the Mark V gun.

Filling Cartridges.

Care will be taken to see that the empty cartridges are properly dry before being filled.

$22\frac{1}{2}$ lb. Prism Black, or 12 lb. E.X.E.

The prisms are built up by hand in a zinc envelope open at both ends, having as many sides, and being of the same length as the finished cartridge, fitted with a movable wooden bottom, secured by three screws; the envelope is placed on a pedestal less in diameter than itself, and filled with the required number of complete layers of prisms.

The empty cartridge is then pulled downwards over the envelope, the screws holding the wood bottom taken out, and the envelope drawn down from between the prisms and the empty cartridge.

The empty cartridge is then held down tightly over the prisms while the braids are being secured, commencing with the bottom braid.

The cartridge is then reversed, and after the wood bottom has been taken out, it is placed on the scales, and the necessary prisms removed from the top layer, or added to it, until the weight is correct.

The superfluous choke is then cut off to within one inch of the top layer of prisms: a few vertical cuts are then made in this overlap, which is turned in until the edge is flush with the charge; the top is then placed on and secured at each side, and then oversewn round with two strands of silk twist.

In making up charge of Prism¹ powder the top layer should not contain less than 75 per cent. of the number of prisms in a complete layer, one or more prisms being taken from each complete layer to make up the requisite number in the top layer.

The top and bottom of the cartridge have each a hole in the centre fitted with network, which is covered over with shalloon patches, stuck on with shellac, to prevent the powder dust from falling into the package.

These cartridges, if necessary, may be made up by careful manipulation without using a zinc cylinder, by building up the prisms on a wooden bottom cut to the same shape as the cartridge.

21 lb. P.

The charge will be carefully weighed out, and inserted by means of the "Funnel, cartridge."

The cartridges will be choked by drawing together the mouth into several plaits with a nickel silver needle, threaded with silk twist; after drawing together the mouth of the cartridge, three turns will be taken round the plaits, and the choke thus formed will be further secured by passing the needle four times through it alternately above and below the turns, thereby stitching down the turns round the choke at two points equidistant from each other.

The cartridges will be made up to their proper lengths and diameters by means of the hoops which should be drawn tight so as to make a firm cartridge. The hooping is done as follows: Draw the braid through the silk cloth until the knot of the loop comes home to the silk cloth, the single end being already passed through the loop from underneath; pass the single end to one side of and under the loop, then draw the hoop tight and keep it so by placing the forefinger of the left hand firmly on the loop; bring the running end between itself and the loop, and draw tight the single bend thus formed, *taking care that the bend bites on the loop and not on the single end*, otherwise the knot will slip. The maintenance of the proper form of the cartridge depends on the hooping being thus secured.

Marking Filled Cartridges

Cartridges will be marked with the nature of powder they contain. A record of powder used in all cartridges, with maker's name, lot, and date of filling, will be marked on the package, and will be kept in a book for reference.

All cartridges issued from store filled will have the initial or monogram of the station at which they are filled, stamped on the bottom end.

The cartridges filled by the Royal Artillery will be distinguished by having no initial letter or monogram stamped upon them. This order does not apply to cartridges filled by working parties of Royal Artillery for the Ordnance Store Department.

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Finished Cartridges.

All cartridges will be very carefully examined and gauged as to length and diameter previous to packing.

Materials.

The amount of silk twist required to complete 100 filled cartridges is as follows :—

	oz.	dr.		oz.	dr.
12 lb. E.X.E.	..	4 0	17 lb. P ²	..	1 8
21 lb. P ²	..	1 8	22½ lb. Prism ¹ blk.	4	0
			7 lb. blank	..	1 0

Securing Lids, Stacking, and Painting Powder Cases.

Luting for Securing Lids.

The luting to be used for securing the lids of powder cases and cartridge cylinders will consist of equal parts of bees' wax and tallow. It will be issued from Woolwich properly mixed in metal lined or other suitable packing cases.

Luting, when used *cold*, will be beaten up with an ordinary wood mallet in a wooden tray until it is of the required consistency.

Securing Lids of Metal-Lined Cases.

Cover the side of the bung all round flush to the bottom and the top rim with *cold* luting, press the bung well home into the bung-hole, and fill up the recess round the rim of the bung with *cold* luting, then with the thumb smooth off the luting flush with the bung and case; wipe clean with a piece of cotton waste or rag, close the lid of the case and screw down alternately the two gun-metal bolts with the metal key, giving not more than one turn at a time with each bolt, so as not to strain the bolts or hinges.

To open the case, unscrew alternately the two gun-metal bolts with the metal key, giving not more than one turn at a time with either bolt until both bolts are free, then raise the lid and lift out the bung.

Quantity of Material.

The quantity of luting required for securing 100 cases, powder, metal-lined, whole, is 11½ lbs.

Painting.

Metal-lined cases are painted with three coats of drab paint outside and one coat inside; the inside of the lid is not painted.

TUBES.

(Plates *XLI* to *XLIII*.)

Tubes, vent-scaling	{	Electric P., Marks II., III., and IV.
		Electric P., drill, Marks I., II., and III.
		Percussion, Marks II. and III.
		Percussion, drill, Mark I.

The percussion lock arrangement necessitates a special tube for firing the charge, and this tube performs a double duty in sealing the vent when fired so as to prevent the escape of gas. The tubes, both for service and drill, are made of two patterns for firing by hand or by electricity.

Tube, Vent-sealing, Electric P., Mark III.

Plate XLI.

It is made of brass, bored out to receive the arrangement for firing by electricity. The insulated wires, which are tinned all over, entering through the head, pass through a plug of asbestos and through a conical plug of ebonite; the two ends are soldered with pure tin into two tinned copper poles, which are connected by a bridge of platinum wire surrounded by a small quantity of guncotton dust and mealed gunpowder, enclosed in a case or cylinder of thin ebonite, having a thin paper disc over the end; the remainder of the space is filled with loose gunpowder (F.G.). The bottom end is closed similarly to those of the other vent-sealing tubes.

There is a small air space left between the plugs of asbestos and ebonite. On firing the gun, the pressure forces the ebonite plug up the cone and on to the asbestos, thus preventing any escape of gas.

Externally the head of the tube is flat, the insulated wires being laid down in two grooves on the top, as shown in the woodcut, so as to project sideways. They extend about 18 inches.

Mark I had not the tinned wires and poles, and ordinary soft solder was used for fixing the bridge.

Mark II differs only from Mark III in having wires 18 inches instead of 21 inches in length.

Mark IV differs from Mark III in having wires 22 inches long and its end closed by a brass ball embedded in sulphur and secured with shellac.

Tube, Vent-sealing, Percussion, Mark II.

Plate XLIII.

This consists of a body, anvil, striker, washer, percussion cap, copper disc, two paper discs, and a cork plug. The body is made of brass, solid drawn, a hole is drilled through the head to receive the striker, which is secured in position by being countersunk into the washer as shown in the plate. The upper part of the chamber is screwed and fitted with an anvil, on which is placed the percussion cap, the upper surface of which is in contact with the striker; a small fire-hole is drilled through the axis of the anvil. The remainder of the space in the tube is filled with loose pistol powder, and the bottom is closed with a paper disc and cork plug, coated with varnish.

On firing the gun, the point of the striker of the percussion lock drives the striker of the tube, together with the percussion cap, on to the anvil, thus firing the tube.

Mark III differs from Mark II in having the end closed by a brass ball embedded in sulphur, and secured with shellac, and in having two diagonal fire holes through the anvil as well as the central hole.

Tube, Vent-sealing, Electric, P. Drill, Mark I.

Plate XLII.

The body of this tube is made of gun-metal, in three parts, screwed together and milled outside as shown in the woodcut. There are two

escape holes through the head, and two holes lined with ebonite cylinders, through which the wire terminals pass and project into the interior to form the poles.

The wires are connected by a platinum silver bridge soldered to them.

The tube is issued empty. When required for use it will be charged with a small quantity of priming composition (§ 2866), the escape holes being lightly stopped with luting on the outside.

Mark II differs from Mark I in the wires being led out at the side of the head instead of being merely recessed into it as in the Mark I; the wires are thus better protected from the lock. The wires are 21 inches long instead of 18 inches and are whipped together with black thread at the ends next the tube, and the free ends are twisted into spirals instead of being soldered into brass clinches.

Mark III differs only from Mark II in having wires 22 inches long instead of 21 inches.

Tube, Vent-sealing, Percussion Drill.

Plate XLIII.

This tube is made of gun-metal, the interior being bored out and the head fitted to receive the coned india-rubber plug as shown in the woodcut. The lower part is closed by a gun-metal plug.

TUBE EXTRACTORS.

Plate XLIV.

Vent-sealing tubes require particular means to withdraw them from the vent. There are two instruments provided, one the "Extractor Tube 'P'" for ordinary use, and one the "Extractor Tube 'P' Special" for *special* use when the tube is jammed beyond the power of the other to extract.

To use the former the lock is first drawn back, and the jaws of the extractor are inserted under the head of the tube on the side opposite the lock; the handle of the extractor is depressed, thus loosening the tube, which can then be withdrawn from the vent.

The special extractor consists of a sheath, containing a bolt with a screw thread on the inner end, and two small levers hinged to the outer end, which is square in section to prevent turning inside the sheath. A revolving cross-handle actuates the threaded portion of the bolt, moving it in or out, according to the direction in which the handle is turned. A small bar between the levers causes them to diverge on passing out of the sheath; and their outer ends, which are semi-circular in form, are lipped so as to clip the head of the tube.

When using this extractor, it will be found convenient to remove the percussion lock. The cross-handle is then turned till the ends of the levers protrude sufficiently to admit of their being placed over the head of the tube. On turning the cross-handle in the opposite direction, the tube is gripped and forcibly extracted.

Either end of the cross-handle serves as a wrench for the securing out of the striker in the percussion lock.

NOTES.

In the event of a miss-fire with a percussion tube, a pause of half a minute is to be made before re-cocking the lock.

In the event of a tube failing to ignite a cartridge, *care should be taken in extracting the fired tube not to stand directly in rear of the gun*, as the gas generated will cause the tube to fly out with some violence when eased by the extractor.

The vent sometimes becomes choked with residue or a piece of the cartridge. It should be cleared as much as possible with a bit and a tube inserted and fired to blow out the rest of the obstruction. A friction tube in the front of the cup and the breech open, or a P tube in the ordinary manner,* may be used for this purpose.

A tube is not to be inserted till the breech-screw is closed. If in the event of a tube missfiring it is desired to open the breech, always extract the tube first, and it is not to be replaced till the breech is closed.

The striker is always to be recocked by means of a lanyard held at some distance.

Instructions for the Management and Preservation of Battery-Electric Firing, 3-cell, Le Clanché.

The battery consists of three Le Clanché cells, a firing key, and the necessary connections fitted into a wooden case. The poles are connected, one direct to a binding screw, and the other to the nipple of the firing key, the arm of which is connected to the other binding screw.

In order to preclude risk of accident, the firing key is fitted with a spring safety catch, which must be pulled out and kept out to enable the key to be pressed down.

When supplied, the cells are charged with dry sal-ammoniac only, and sealed up; the batteries are consequently inactive, and must be prepared for service by pouring into each cell about a pint of a cold three-fourths saturated solution of sal-ammoniac, prepared by dissolving $4\frac{1}{2}$ ozs. of the salt (crushed) in one pint of boiling water, the sal-ammoniac being added gradually till it is all dissolved.

After the battery has been charged, and the wires attached, the test bridge is to be applied to the ends of the wires in the same way as the fuzes and detonators are afterwards applied; the cover of the test bridge should then be removed, so that the wire bridge may be seen; and, if on completing the circuit with the battery the bridge becomes bright red hot, the battery and wires are in a serviceable condition. Should the bridge not become red hot, the insulated wire should be removed, and the test bridge applied direct to the terminals. It will thus be ascertained whether the battery or the wire is at fault. The battery must not be expected to attain its full strength until half-an-hour after it has been charged.

As a Le Clanché battery is very liable to become polarised, or "run down," as it is commonly called, by being put on short circuit, and

* When using a Mark III tube for this purpose, care should be taken that the range is clear, as the brass ball is projected to a considerable distance.

as the effect of this polarisation will, to a great extent, disappear in time, it is advisable before taking the battery to pieces for renovating, if time permits, to have it for a few days disconnected, testing it every day to see if it is improving.

As no local action takes place in this cell when the circuit is open, the solution when once poured in should not be emptied out again, unless for packing, or when it is found that the battery is exhausted and requires a fresh solution.

Instructions for the Management and Preservation of The Menotti Test Battery.

The outer vessel is of ebonite, at the bottom of which is a copper cup $\frac{1}{2}$ -inch deep and $3\frac{1}{2}$ inches in diameter, containing two ounces of crystals of sulphate of copper, with a "fearnought" diaphragm on top. Above this is 3 inches of fine sawdust that has been moistened with clean fresh water and laid in loosely. On top of this layer of sawdust is another diaphragm and then a slab of zinc $\frac{1}{2}$ -inch thick, $3\frac{1}{2}$ inches in diameter, and weighing 2 lbs. The upper portion of the zinc and its connection with the insulated wire are carefully insulated.

As this cell is only used for testing purposes, a low resistance (about 20 ohms), astatic galvanometer is permanently attached to the ebonite disc which forms the core of the cell; together with a key which closes the circuit through the wires or tube under test. The whole is fitted into a leather case.

The batteries are supplied with the sulphate of copper, fearnought diaphragms and sawdust in place, but dry and consequently inactive. They are prepared for service by taking out the sawdust, soaking it in clean fresh water (or better still, in a solution of sulphate of zinc), then squeezing it out to a certain extent and replacing it; the advantage of this method being that the cell will be ready for use at once. If the water were merely poured on to the sawdust, some hours or even days will elapse before the cell is ready for use. If any sulphate of copper crystals are spilt among the sawdust, care should be taken to remove them all, or to use fresh sawdust, for if the sulphate of copper is allowed to come into contact with the zinc it will at once deposit copper on the zinc.

Test.—After being rendered active it should be tested by joining a short wire between the positive pole of the battery and the free terminal of the galvanometer, then placing the instrument so that the needle points to zero and pressing the key, a deflection of between 80° and 85° should be shown. This is called "Testing the battery on short circuit."

A magnet is supplied for the purpose of steadying the needle when there is motion, or reducing the deflection when it is too great; when not required for use it is kept in a pocket in the strap of the leather containing case.

After the test battery has been in action six months the sawdust is to be changed and the copper cup recharged with sulphate of copper. Any copper sulphate crystals found can be used over again. At the same time the connections of the insulated wires with the zinc and the copper cup should be carefully examined, and the incrustation cleaned from the zinc so as to leave a clean surface on the under side at any rate.

Should the battery show indications of loss of power, and these measures fail to restore it, a new battery must be rendered active.

Battery and Key, Test and Firing.

The firing key and battery is designed to serve two purposes:—

- (i.) To test the tube and circuit when the gun is made ready to fire.
- (ii.) To fire the tube.

To enable this to be done an indicator is fitted within the firing key itself, which is so arranged that when the knob is turned to the right the current passes through the indicator and the rest of the gun circuit, and if this is complete a visible and audible signal is given. If it be then required to fire, the button is pressed in, which action cuts the indicator out and allows the full current to flow through the circuit, firing the tube. An arrow on the knob indicates the safety position.

Besides this, the apparatus may take the place of the Menotti cell and galvanometer for testing tubes and firing wires.

The Le Clanché cells, of which there are two in the battery box, are issued with the sal-ammoniac in them; all that is required to make them ready for use is to fill the cells two-thirds full with water, and to see that this is added from time to time to make up for evaporation.

When the battery fails to fire a tube, fresh sal-ammoniac (about four ounces to each cell) should be added, the old solution being thrown away.

The apparatus is suitable for firing any low tension fuze or tube through a short length of wire, about 50 yards of No. 16 copper wire (.065" diameter).

Precautions to be observed.

The firing wires must not both be connected up until after the gun is laid and ready to fire, and the front is clear. The turning of the knob should be done just before it is required to fire, and it may either be held turned or not, as desired, until the gun is fired by pressing it in.

The following rules will detect the particular cause of failures to fire with electric tubes:—

- (1.) If the indicator works properly and yet when the knob is pressed the tube does not fire, the fault is a short circuit between the firing leads, or in the tube itself.
- (2.) If the indicator works feebly, some bad joint in the circuit will be the probable cause.
- (3.) If it does not move at all the circuit is broken at some point, either in the wires, or in the tube itself.
- (4.) If the indicator works when the knob is turned and the gun does not fire when it is pressed, and then when the knob is turned again the indicator does not work, this shows that the tube has fired without igniting the charge.

To eliminate faulty tubes it is as well to test them before use, out of the gun. This should be done under precaution, so that in the case of a tube being accidentally fired, no damage would ensue. The firing leads may also be tested; and the apparatus may be considered to be in good order if on joining the terminals with a short piece of wire and turning the knob the indicator works well. If it should only work feebly the battery should be examined, as in this case it will not give sufficient current to fire with certainty.

RANGE TABLE FOR 6-INCH B.L. GUN, MARK IV.

Charge 42 lb. P.*
 Projectile, 100 lb.
 Muzzle velocity, 1850 f.s.†

Mounting, E.O.C.
 Jump, 7 minutes.

Range.	Elevation.	Angle of Descent.	Remaining Velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically or laterally at each range.	Fifty per cent. of rounds should fall within			Time of Flight.	Fuze Scale. Armstrong medium time, and concussion fuze.	Fuze scale, for time, sensitive, middle fuze.	Penetration of wrought iron.
						Length.	Breadth.	Height.				
yards.	°	'	f.s.	yards.	yards.	yards.	yards.	yards.	secs.	inches.		inches.
100	0	3	1823	97.0	0.14	18.0	0.03	0.03	0.16			11.4
200	0	8	1796	95.0	0.29	18.0	0.06	0.06	0.33			11.2
300	0	17	1770	93.0	0.43	18.0	0.09	0.09	0.50			11.0
400	0	23	1745	91.1	0.58	18.0	0.12	0.12	0.66		2.1	10.9
500	0	29	1720	89.2	0.72	18.0	0.15	0.15	0.83		2.5	10.7
600	0	36	1694	87.4	0.87	18.0	0.18	0.18	1.0		3.0	10.5
700	0	42	1669	85.7	1.01	18.0	0.21	0.22	1.18		3.5	10.4
800	0	48	1643	84.1	1.16	18.0	0.24	0.25	1.35		4.0	10.2
900	0	55	1618	82.5	1.31	18.0	0.27	0.28	1.52		4.5	10.0
1000	0	61	1594	81.0	1.45	18.0	0.30	0.32	1.70		5.0	9.8
1100	0	68	1569	79.5	1.60	18.1	0.34	0.36	1.89		5.5	9.7
1200	0	75	1545	78.0	1.74	18.1	0.37	0.40	2.08		6.0	9.5
1300	1	8	1521	76.8	1.89	18.1	0.41	0.44	2.27	0.50	6.5	9.4
1400	1	11	1497	75.4	2.03	18.2	0.44	0.49	2.46	0.72	7.0	9.2
1500	1	18	1473	74.0	2.18	18.2	0.48	0.53	2.65	0.91	7.5	9.1
1600	1	24	1450	72.7	2.32	18.2	0.51	0.58	2.85	1.07	8.0	8.9
1700	1	31	1427	71.5	2.47	18.3	0.55	0.63	3.05	1.21	8.6	8.7
1800	1	37	1404	70.3	2.61	18.3	0.59	0.68	3.26	1.35	9.2	8.6
1900	1	44	1381	69.2	2.76	18.4	0.63	0.73	3.47	1.49	9.8	8.4
2000	1	51	1359	68.1	2.91	18.5	0.66	0.79	3.68	1.64	10.4	8.3
2100	1	58	1338	67.0	3.05	18.7	0.70	0.85	3.90	1.78	11.0	8.1
2200	2	5	1316	65.9	3.20	18.9	0.75	0.92	4.12	1.93	11.6	8.0
2300	2	13	1295	64.8	3.34	19.2	0.79	0.99	4.34	2.08	12.2	7.9
2400	2	20	1276	63.7	3.49	19.5	0.83	1.07	4.57	2.23	12.8	7.8
2500	2	28	1256	62.6	3.63	19.9	0.88	1.15	4.80	2.37	13.4	7.6
2600	2	35	1238	61.6	3.78	20.3	0.92	1.24	5.04	2.52	14.1	7.5
2700	2	44	1220	60.6	3.92	20.7	0.97	1.33	5.28	2.67	14.7	7.4
2800	2	52	1203	59.6	4.07	21.1	1.01	1.43	5.52	2.83	15.4	7.3
2900	3	0	1186	58.7	4.21	21.5	1.06	1.53	5.76	2.99	16.1	7.1
3000	3	9	1170	57.8	4.36	22.0	1.11	1.64	6.01	3.15	16.8	7.0
3100	3	17	1154	56.9	4.51	22.4	1.15	1.75	6.26	3.30	17.5	6.9
3200	3	26	1139	56.1	4.65	22.8	1.20	1.87	6.51	3.45	18.2	6.8
3300	3	35	1124	55.2	4.80	23.2	1.25	2.0	6.77	3.60	18.9	6.7
3400	3	45	1110	54.4	4.94	23.6	1.30	2.13	7.02	3.76	19.6	6.6
3500	3	55	1096	53.6	5.09	24.0	1.35	2.27	7.28	3.92	20.3	6.5
3600	4	5	1083	52.8	5.23	24.4	1.40	2.42	7.55	4.09	21.0	6.4
3700	4	14	1071	52.0	5.38	24.8	1.45	2.57	7.82	4.26	21.7	6.3
3800	4	24	1059	51.2	5.52	25.2	1.50	2.73	8.09	4.43	22.4	6.2
3900	4	35	1048	50.4	5.67	25.6	1.55	2.90	8.37	4.60	23.1	6.1
4000	4	45	1037	49.6	5.81	26.0	1.61	3.08	8.65	4.77	23.9	6.0
4100	4	56	1029	48.7	5.96	26.5	1.66	3.27	8.94		24.7	
4200	5	7	1022	47.9	6.11	26.9	1.72	3.47	9.23		25.5	5.9
4300	5	18	1015	47.1	6.25	27.4	1.77	3.68	9.53		26.3	
4400	5	29	1008	46.3	6.40	27.8	1.83	3.90	9.82		27.1	
4500	5	40	1001	45.5	6.54	28.3	1.89	4.12	10.1		27.9	5.8
4600	5	52	994	44.7	6.69	28.7	1.95	4.35	10.4		28.7	
4700	6	4	987	44.0	6.83	29.2	2.01	4.58	10.7		29.5	5.7
4800	6	15	980	43.2	6.98	29.6	2.07	4.82	11.0			
4900	6	27	973	42.6	7.13	30.1	2.03	5.07	11.3			
5000	6	39	967	42.0	7.27	30.6	2.20	5.33	11.6			5.6

* This Range Table is also suitable for the 45 lb. Prism Black charge.

† The muzzle velocity has been found to vary from 1833 to 1830 f.s., according to the brand of powder used. An increase of 100 f.s. in the muzzle velocity increases the range at ordinary ranges about 8 per cent.

RANGE TABLE FOR 6-INCH B.L. GUN, MARK IV—continued.

Range.	Elevation.		Angle of Descent.		Remaining Velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically or laterally at each range.	Fifty per cent. of rounds should fall within			Time of Flight.	Fuze Scale, Armstrong medium time and concussion fuze.	Fuze scale for time, sensitive, middle fuze.	Penetration of wrought iron.
								Length.	Breadth.	Height.				
yards.	°	'	°	'	f.s.	yards.	yards.	yards.	yards.	yards.	secs.	inches.		inches.
5100	6	52	10	12	961	41.3	7.42	31.1	2.27	5.60	11.9			
5200	7	4	10	32	955	40.7	7.50	31.6	2.34	5.88	12.2			5.5
5300	7	16	10	52	949	40.1	7.61	32.1	2.41	6.18	12.6			
5400	7	28	11	12	943	39.6	7.85	32.7	2.49	6.50	12.9			
5500	7	41	11	32	937	39.1	8.00	32.2	2.57	6.83	13.2			5.4
5600	7	54	11	53	932	38.7	8.14	32.8	2.65	7.18	13.5			
5700	8	7	12	13	926	38.3	8.29	33.3	2.73	7.56	13.9			
5800	8	20	12	34	921	37.9	8.43	33.9	2.82	7.95	14.2			5.3
5900	8	33	12	55	915	37.4	8.58	35.4	2.91	8.35	14.6			
6000	8	46	13	16	910	37.0	8.73	36.0	3.0	8.75	15.0			
6100	8	59	13	38	905	36.5	8.87				15.3			5.2
6200	9	12	14	0	900	36.1	9.01				15.7			
6300	9	26	14	22	895	35.6	9.16				16.0			
6400	9	39	14	45	891	35.2	9.30				16.4			5.1
6500	9	53	15	8	886	34.8	9.45				16.7			
6600	10	7	15	31	882	34.3	9.60				17.1			
6700	10	21	15	54	877	33.8	9.74				17.5			5.0
6800	10	36	16	18	873	33.4	9.89				17.8			
6900	10	51	16	42	869	33.0	10.03				18.2			
7000	11	7	17	6	865	32.6	10.18				18.6			4.9
7100	11	22	17	29	861	32.2	10.32				19.0			
7200	11	38	17	53	857	31.9	10.46				19.3			
7300	11	53	18	17	853	31.6	10.60				19.7			
7400	12	9	18	41	850	31.3	10.75				20.1			
7500	12	25	19	6	846	31.0	10.89				20.5			4.8
7600	12	41	19	31	843	30.7	11.04				20.8			
7700	12	57	19	56	839	30.4	11.19				21.2			
7800	13	14	20	22	836	30.1	11.34				21.6			
7900	13	31	20	48	832	29.8	11.48				22.0			
8000	13	48	21	15	829	29.5	11.63				22.4			4.7
8100	14	5	21	42	826	29.2	11.77				22.8			
8200	14	22	22	9	824	28.9	11.92				23.2			
8300	14	39	22	37	822	28.6	12.07				23.6			
8400	14	56	23	6	820	28.3	12.22				24.0			4.6
8500	15	14	23	35	818	28.0	12.36				24.4			
8600	15	32	24	4	815	27.7	12.50				24.8			
8700	15	50	24	33	813	27.4	12.65				25.2			
8800	16	8	25	2	811	27.1	12.80				25.6			
8900	16	26	25	31	809	26.8	12.94				26.0			
9000	16	45	26	0	807	26.6	13.08				26.4			4.5
9100	17	4	26	30	805	26.3	13.23				26.9			
9200	17	23	27	0	803	26.1	13.37				27.5			
9300	17	42	27	31	802	25.8	13.52				27.9			
9400	18	2	28	1	800	25.5	13.66				28.1			
9500	18	21	28	32	799	25.2	13.81				28.5			
9600	18	41	29	3	797	25.0	13.96				29.0			
9700	19	1	29	34	796	24.7	13.11				29.4			
9800	19	21	30	6	794	24.5	14.26				29.8			
9900	19	42	30	38	793	24.2	14.40				30.2			
10000	20	3	31	10	792	24.0	14.55				30.6			4.4

RANGE TABLE FOR 6-INCH B.L. GUN, MARKS IV AND VI.

Based on Practice 3.4.88 and 19.4.88.

Minute, 15,236.

Charge { Weight, 48 lb.
Gravimetric density $\frac{28.4}{0.976}$
Nature of powder, E.X.E. } Projectile { Nature, Common Shell.
Weight, 100 lb.
Muzzle velocity, 1,960 f.s.
Jump, 7 minutes.

Range.	Elevation.	Middle, T. and P. fuze scale.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically or laterally at each range.	Remaining Velocity.	Time of Flight.	Angle of Descent.	Fifty per cent. of rounds should fall within		
								Length.	Breadth.	Height.
yards.	° ' "		yards.	yards.	f.s.	seconds.	° ' "	yards.	yards.	yards.
0	0 0									
100	0 0	0.5	111	0.14	1931	0.16	0 5	30	0.1	0.0
200	0 3	1.0	109	0.29	1932	0.32	0 10	29	0.1	0.0
300	0 7	1.5	107	0.43	1874	0.48	0 15	28	0.1	0.1
400	0 12	2.1	106	0.58	1847	0.65	0 20	27	0.2	0.1
500	0 16	2.6	104	0.72	1820	0.81	0 25	27	0.2	0.1
600	0 21	3.1	103	0.87	1793	0.98	0 30	26	0.2	0.2
700	0 26	3.6	101	1.01	1766	1.15	0 35	25	0.3	0.2
800	0 31	4.2	100	1.16	1740	1.32	0 41	24	0.3	0.2
900	0 36	4.7	98	1.31	1713	1.49	0 46	24	0.4	0.3
1000	0 41	5.2	96	1.45	1687	1.67	0 53	23	0.4	0.3
1100	0 46	5.7	95	1.60	1661	1.84	0 59	22	0.5	0.3
1200	0 52	6.3	93	1.74	1636	2.02	1 5	21	0.5	0.3
1300	0 57	6.8	92	1.89	1611	2.20	1 11	21	0.6	0.4
1400	1 3	7.3	90	2.03	1586	2.38	1 18	20	0.6	0.4
1500	1 8	7.8	89	2.18	1561	2.56	1 25	20	0.7	0.4
1600	1 14	8.4	87	2.32	1537	2.74	1 32	19	0.7	0.4
1700	1 20	8.9	85	2.47	1513	2.92	1 39	19	0.8	0.5
1800	1 26	9.5	84	2.61	1489	3.11	1 47	18	0.8	0.5
1900	1 32	10.0	82	2.76	1466	3.30	1 55	18	0.9	0.5
2000	1 38	10.6	81	2.91	1443	3.50	2 4	18	0.9	0.6
2100	1 44	11.1	79	3.05	1421	3.69	2 13	17	1.0	0.6
2200	1 50	11.7	78	3.20	1399	3.89	2 22	17	1.0	0.7
2300	1 56	12.2	76	3.34	1377	4.09	2 31	17	1.1	0.7
2400	2 3	12.8	75	3.49	1356	4.29	2 41	17	1.1	0.8
2500	2 9	13.4	73	3.63	1335	4.49	2 51	17	1.2	0.8
2600	2 16	14.0	72	3.78	1315	4.70	3 1	17	1.2	0.9
2700	2 23	14.6	70	3.92	1295	4.91	3 12	17	1.3	0.9
2800	2 30	15.2	69	4.07	1275	5.12	3 23	17	1.3	1.0
2900	2 37	15.8	68	4.21	1256	5.34	3 35	17	1.4	1.0
3000	2 45	16.4	67	4.36	1238	5.56	3 47	17	1.4	1.1
3100	2 53	17.0	65	4.51	1220	5.78	3 59	17	1.5	1.1
3200	3 0	17.7	64	4.65	1203	6.01	4 12	17	1.5	1.2
3300	3 8	18.3	62	4.80	1186	6.25	4 25	18	1.6	1.3
3400	3 16	19.0	61	4.94	1169	6.49	4 38	18	1.6	1.4
3500	3 24	19.7	60	5.09	1153	6.74	4 52	18	1.7	1.5
3600	3 33	20.4	59	5.23	1137	7.00	5 6	19	1.7	1.7
3700	3 41	21.1	58	5.38	1122	7.26	5 21	19	1.7	1.8
3800	3 50	21.9	57	5.52	1107	7.53	5 36	20	1.7	2.0
3900	3 59	22.6	55	5.67	1093	7.80	5 52	20	1.8	2.1
4000	4 8	23.4	54	5.81	1080	8.08	6 8	21	1.8	2.3
4100	4 17	24.1	53	5.96	1068	8.35	6 24	21	1.9	2.4
4200	4 27	24.9	52	6.11	1056	8.63	6 41	22	1.9	2.6
4300	4 36	25.6	51	6.25	1045	8.91	6 58	23	2.0	2.8
4400	4 46	26.4	50	6.40	1035	9.20	7 15	24	2.0	3.0
4500	4 56	27.1	50	6.54	1025	9.49	7 32	24	2.1	3.2
4600	5 6	27.9	49	6.69	1016	9.78	7 50	25	2.2	3.5
4700	5 16	28.7	48	6.83	1008	10.07	8 8	26	2.2	3.7
4800	5 26	29.5	47	6.98	1000	10.36	8 26	27	2.3	4.0
4900	5 36		46	7.13	992	10.65	8 45	28	2.3	4.3
5000	5 47		45	7.27	984	10.75	9 4	29	2.4	4.6

RANGE TABLE FOR 6-INCH B.L. GUN, MARKS IV AND VI—continued.

Range.	Elevation.	Middle, T. and P. fuze scale.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically or laterally at each range.	Remaining Velocity.	Time of Flight.	Angle of Descent.	Fifty per cent of rounds should fall within		
								Length.	Breadth.	Height.
yards.	° /		yards.	yards.	f.s.	seconds.	° /	yards.	yards.	yards.
5100	5 58		45	7.42	977	11.25	9 23	30	2.5	4.9
5200	6 10		44	7.56	970	11.56	9 43	31	2.6	5.3
5300	6 22		44	7.71	962	11.87	10 3	32	2.7	5.6
5400	6 34		43	7.85	955	12.18	10 23	33	2.8	6.0
5500	6 46		42	8.00	948	12.49	10 33	34	2.9	6.4
5600	6 58		41	8.14	941	12.80	11 4	35	3.0	6.8
5700	7 10		41	8.29	934	13.11	11 25	36	3.1	7.2
5800	7 23		40	8.43	927	13.43	11 46	37	3.3	7.7
5900	7 35		40	8.58	920	13.74	12 7	38	3.4	8.2
6000	7 48		39	8.73	913	14.06	12 23	40	3.5	8.7
6100	8 1		39	8.87	907	14.37	12 49	41	3.6	9.2
6200	8 14		38	9.01	900	14.69	13 10	42	3.8	9.8
6300	8 27		38	9.16	893	15.00	13 31	43	3.9	10.4
6400	8 41		37	9.30	887	15.32	13 52	45	4.1	11.0
6500	8 54		37	9.45	881	15.63	14 13	46	4.2	11.6
6600	9 8		36	9.60	875	15.95	14 34	48	4.4	12.3
6700	9 22		36	9.74	869	16.27	14 55	49	4.6	13.0
6800	9 36		36	9.89	863	16.59	15 16	51	4.8	13.8
6900	9 50		35	10.03	857	16.91	15 37	52	5.0	14.6
7000	10 5		35	10.18	851	17.23	15 57	54	5.2	15.4
7100	10 19		35	10.32	845	17.55	16 18	55	5.4	16.2
7200	10 34		35	10.46	839	17.88	16 39	57	5.6	17.1
7300	10 49		34	10.60	833	18.21	17 0	58	5.8	18.0
7400	11 4		34	10.75	828	18.54	17 21	61	6.0	19.0
7500	11 19		34	10.89	822	18.87	17 42	63	6.2	20.0
7600	11 34		34	11.04	817	19.21	18 4	65	6.4	21.0
7700	11 49		34	11.19	811	19.55	18 26	66	6.6	22.1
7800	12 4		33	11.34	805	19.89	18 48	68	6.9	23.3
7900	12 19		33	11.48	800	20.23	19 10	70	7.1	24.5
8000	12 35		33	11.63	795	20.58	19 33	72	7.3	25.6
8100	12 50		33	11.77	790	20.93	19 56	74	7.5	26.9
8200	13 6		32	11.92	785	21.28	20 20	76	7.8	28.2
8300	13 21		32	12.07	780	21.63	20 44	78	8.0	29.6
8400	13 36		32	12.22	775	21.98	21 8	80	8.3	31.0
8500	13 51		32	12.36	770	22.33	21 32	82	8.6	32.4
8600	14 7		31	12.50	765	22.69	21 57	84	8.9	33.9
8700	14 22		31	12.65	760	23.05	22 22	86	9.1	35.4
8800	14 38		31	12.80	756	23.42	22 47	88	9.4	37.0
8900	14 54		31	12.94	751	23.79	23 12	90	9.6	38.6
9000	15 10		30	13.08	746	24.16	23 38	92	9.9	40.3
9100	15 26		30	13.23	742	24.53	24 4	94	10.2	42.0
9200	15 43		30	13.37	737	24.90	24 31	97	10.5	43.8
9300	15 59		30	13.52	732	25.27	24 59	99	10.8	45.5
9400	16 16		29	13.66	728	25.65	25 27	101	11.1	47.3
9500	16 33		29	13.81	723	26.03	25 55	103	11.4	49.1
9600	16 50		29	13.96	718	26.41	26 24	106	11.7	50.9
9700	17 8		28	14.11	714	26.79	26 53	108	12.0	52.7
9800	17 26		28	14.26	709	27.18	27 23	111	12.3	54.6
9900	17 44		27	14.40	704	27.56	27 53	113	12.6	56.5
10000	18 3		27	14.55	699	27.95	28 23	116	13.0	58.5

RANGE TABLE FOR 6-INCH B.L. MARK V GUN.

Based on Practice of 20,586.

*Charge, 43 lb. P.²; gravimetric
density, $\frac{34.3}{0.808}$.
Projectile, 100 lbs.

Mounting, E.O.C. Hydro-Pneumatic.
Jump, 7 minutes.
Muzzle velocity, 1,917 f.s.

Range.	Elevation.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically or laterally at each range.	Angle of Descent.	Remaining Velocity.	Time of Flight.	Fifty per cent. of rounds should fall within			Medium time and concussion, fuz. scale.
							Length.	Breadth.	Height.	
yards	° ' "	yards.	yards.	° ' "	f.s.	seconds.	yards.	yards.	feet.	
0										
100		130	0.14	0 5	1889	0.16	18	0.03	0.1	
200	0 1	125	0.29	0 10	1861	0.31	18	0.06	0.3	
300	3 5	120	0.43	0 15	1833	0.46	18	0.09	0.3	
400	0 9	115	0.58	0 20	1806	0.62	18	0.12	0.4	
500	0 13	110	0.72	0 25	1779	0.78	18	0.15	0.5	
600	0 17	105	0.87	0 31	1752	0.94	18	0.18	0.6	
700	0 21	105	1.01	0 37	1726	1.10	18	0.21	0.7	
800	0 26	100	1.16	0 43	1700	1.36	18	0.24	0.8	0.80
900	0 31	100	1.31	0 49	1674	1.53	18	0.27	0.9	0.88
1000	0 36	98	1.45	0 55	1649	1.70	18	0.30	1.0	0.96
1100	0 41	94	1.60	1 1	1624	1.88	18	0.33	1.1	1.04
1200	0 46	92	1.74	1 7	1599	2.06	18	0.37	1.2	1.13
1300	0 51	90	1.89	1 14	1574	2.25	18	0.41	1.3	1.22
1400	0 56	88	2.03	1 21	1549	2.44	18	0.45	1.4	1.31
1500	1 1	86	2.18	1 28	1525	2.64	18	0.49	1.5	1.40
1600	1 7	84	2.32	1 35	1501	2.84	18	0.53	1.6	1.49
1700	1 13	82	2.47	1 42	1477	3.04	18	0.57	1.7	1.58
1800	1 19	80	2.61	1 50	1453	3.25	19	0.61	1.8	1.67
1900	1 25	79	2.76	1 58	1431	3.46	19	0.65	1.9	1.76
2000	1 31	78	2.91	2 6	1409	3.67	19	0.69	2.0	1.86
2100	1 37	76	3.05	2 14	1387	3.89	19	0.73	2.2	1.96
2200	1 44	74	3.20	2 22	1365	4.1	19	0.77	2.4	2.06
2300	1 51	72	3.34	2 31	1344	4.33	19	0.81	2.6	2.17
2400	1 58	71	3.49	2 40	1324	4.56	19	0.85	2.8	2.28
2500	2 5	70	3.63	2 49	1304	4.79	19	0.89	3.1	2.39
2600	2 12	69	3.78	2 58	1285	5.02	20	0.93	3.4	2.5
2700	2 19	68	3.92	3 8	1266	5.25	20	0.97	3.7	2.62
2800	2 26	67	4.07	3 18	1247	5.49	20	1.01	4.0	2.74
2900	2 34	66	4.21	3 28	1228	5.73	21	1.05	4.3	2.87
3000	2 42	65	4.36	3 38	1210	5.97	21	1.10	4.6	3.0
3100	2 50	64	4.51	3 49	1192	6.22	22	1.15	5.0	3.15
3200	2 58	63	4.65	4 1	1175	6.47	22	1.20	5.4	3.30
3300	3 6	62	4.80	4 12	1159	6.73	23	1.25	5.9	3.46
3400	3 14	61	4.94	4 24	1144	6.99	23	1.30	6.4	3.62
3500	3 23	60	5.09	4 37	1129	7.25	24	1.35	6.9	3.79
3600	3 32	59	5.23	4 50	1115	7.51	24	1.40	7.4	3.97
3700	3 41	58	5.38	5 3	1101	7.78	25	1.45	7.9	4.15
3800	3 50	57	5.52	5 16	1089	8.05	25	1.50	8.4	4.33
3900	3 59	56	5.67	5 30	1075	8.33	26	1.55	8.9	4.52
4000	4 9	55	5.81	5 44	1062	8.61	26	1.60	9.4	4.72
4100	4 19	55	5.96	5 59	1051	8.90	27	1.66	10.0	4.93
4200	4 29	54	6.11	6 14	1041	9.17	27	1.72	10.6	
4300	4 39	53	6.25	6 29	1032	9.46	28	1.78	11.2	
4400	4 49	52	6.40	6 45	1023	9.75	28	1.84	11.8	
4500	4 59	52	6.54	7 1	1015	10.04	29	1.90	12.5	

* This Range Table is also suitable for the 45 lb. Prism³ Black Charge.

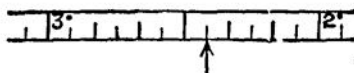
RANGE TABLE FOR 6-INCH B.L. MARK V GUN—continued.

Range.	Elevation.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically or laterally at each range.	Angle of Descent.	Remaining Velocity.	Time of Flight.	Fifty per cent. of rounds should fall within			Medium time and concussion, fuzes scale.
							Length.	Breadth.	Height.	
yards.	° ' "	yards.	yards.	° ' "	f.s.	seconds.	yards.	yards.	feet.	
4600	5 9	51	6 60	7 17	1007	10 34	29	1 96	13 2	
4700	5 19	51	6 83	7 34	999	10 64	30	2 03	13 9	
4800	5 29	50	6 98	7 51	991	10 94	30	2 10	14 6	
4900	5 39	50	7 13	7 8	983	11 25	31	2 17	15 3	
5000	5 50	49	7 27	8 26	975	11 56	31	2 24	16 0	
5100	6 1	49	7 42	8 44	967	12 87	32	2 31	16 8	
5200	6 12	48	7 56	9 2	959	12 19	32	2 38	17 6	
5300	6 23	47	7 71	9 21	952	12 51	33	2 46	18 4	
5400	6 34	46	7 85	9 40	945	12 83	33	2 54	19 2	
5500	6 45	45	8 0	9 59	938	13 15	34	2 62	20 0	
5600	6 57	45	8 14	10 19	931	13 47	34	2 70	20 9	
5700	7 9	44	8 29	10 39	924	13 80	35	2 78	21 8	
5800	7 21	43	8 43	10 59	917	14 13	35	2 86	22 7	
5900	7 34	43	8 58	11 19	910	14 46	36	2 94	23 6	
6000	7 47	42	8 73	11 40	903	14 79	36	3 02	24 6	
6100	8 0	42	8 87	12 1	896	15 12				
6200	8 13	41	9 02	12 22	890	15 46				
6300	8 26	41	9 16	12 43	884	15 80				
6400	8 39	40	9 30	13 4	878	16 14				
6500	8 53	40	9 45	13 26	872	16 48				
6600	9 7	39	9 59	13 48	866	16 82				
6700	9 21	39	9 74	14 10	860	17 17				
6800	9 35	38	9 88	14 32	854	17 52				
6900	9 49	38	10 03	14 55	848	17 87				
7000	10 3	37	10 17	15 18	842	18 22				
7100	10 17	37	10 32	15 42	836	18 57				
7200	10 31	36	10 46	16 6	830	19 33				
7300	10 45	36	10 61	16 30	824	19 29				
7400	11 0	35	10 76	16 54	818	19 65				
7500	11 15	35	10 90	17 19	813	20 01				
7600	11 30	34	11 05	17 44	808	20 38				
7700	11 45	34	11 19	18 10	803	20 75				
7800	12 0	33	11 34	18 36	798	21 12				
7900	12 14	33	11 48	19 3	793	21 49				
8000	12 32	32	11 63	19 30	788	21 87				

INSTRUCTIONS FOR USING WATKIN'S CLINOMETER.

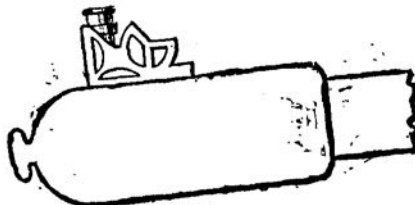
To read the angles marked on the drum.—The brass drum is marked in degrees, commencing at 0° on the top to 45° at the bottom. Each degree is subdivided into twelve parts; each small division therefore represents angles of 5 minutes.

The scale is read from right to left, thus—

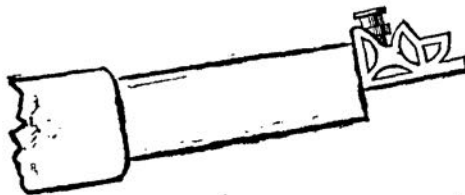


the reading opposite the arrow would indicate an angle of $2^{\circ} 25'$.

To lay a gun or howitzer at any angle up to 45° .—Unscrew the drum until the \uparrow points to the elevation required, place the clinometer thus—

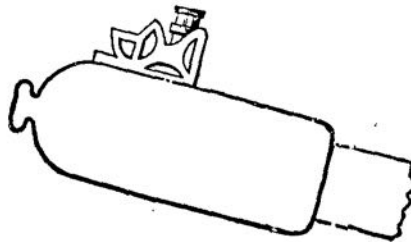


on the plane surface cut on the breech, or against the muzzle, thus—



and elevate the piece until the bubble of the spirit-level is in the centre of the tube.

For angles of depression.—Proceed as above, but reverse the direction of the instrument, placing it thus on the breech of the gun—



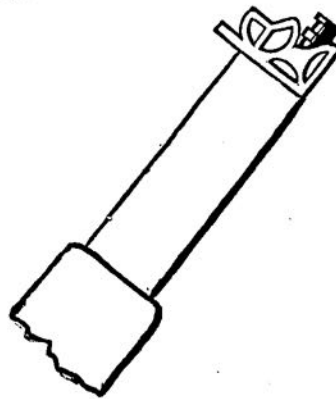
and thus on the muzzle—



For angles of elevation greater than 45°.—Subtract the angle of elevation required from 90°, unscrew the drum to this reading; thus, for 60°, unscrew the drum to 30°, and place the instrument on the breech of the gun, thus—



or on the muzzle, thus—



and elevate until the bubble is in the centre of its run.

NOTE.—Fire, when the elevation given is 35° or under, is called "long range," and when above 35° is called "high angle."

DRILL FOR 6" B.L. GUN ON H.P. MOUNTING.

Gun Detachment.

The gun detachment consists of a Gun Captain (No. 1), § a Gun Layer, and 6 other gun numbers.

It falls in two deep, the Gun Captain being on the left of the front rank, the Gun Layer covering him.

* To Tell Off.

<i>Group Officer.</i> §	<i>Gun Captain.</i>
“.... Group Tell Off.”	“.... Tell Off.”

At “Tell off” the Gun Captain takes a pace to his front, turns to his right, and gives the word “Tell off.”

The Gun Layer does not number.

The right-hand man of the rear rank numbers 2, the right-hand man of the front rank 3, the second man from the right of the rear rank 4, his front rank man 5, and so on.

After the detachment is told off, the Gun Captain falls in again on the left of the front rank.

The detachment is then moved into the work and halted facing the mounting and in rear of it, or to such other convenient position under cover as the Group Officer may direct.

N.B.—When without a Group Officer, the directions, cautions, and commands laid down in this drill to be given by the Group Officer, will be given by the Gun Captain.

General Duties.

“The Gun Captain”† (No. 1) commands, and is responsible to the Group Officer for the regular and efficient service of the gun in all respects.‡

When at practice he is responsible to the Group Officer that his gun is laid on the target ordered.

When his gun is fought by position finder he will insert the firing plug after the gun is laid.

Reads and gives quadrant elevation (Q.E.) to elevating number.

When time fuses are employed he sets them.

The Gun Layer.—His special duty is the laying of the gun.

* This should be done as far as possible on private parade, before marching off from parade, camp, or quarters.

† It is recommended that, when feasible, this non-commissioned officer should have permanent charge of the gun, and be responsible for its condition and cleanliness, and all stores, &c., connected with it, and also for the emplacement in which it is mounted.

‡ When Q.E. is used, or training by arc and pointer, he must especially see that the numbers concerned are exact in their work.

§ In exceptional cases the Gun Captain may also have to perform the duties of Group Officer.

When direction is given by training arc, he reads the training and directs the traversing numbers.

He attends to the vent and percussion lock and makes ready.

No. 2 withdraws and cleans breech-block, rams home, inserts breech-block, traverses, and sponges (if necessary).

No. 3 unlocks breech-block, places loading tray, uncaps fuze or removes safety pin or pins, loads, removes shalloon patch from end of last cartridge, rams home, removes loading tray, locks breech-block, runs up, traverses, and removes residue from chamber and mushroom head, with scraper and brush, after every round.*

No. 4 supplies side arms and loading tray, elevates and fires.

No. 5 assists 7 in all his duties, and runs up.

No. 6 attends outside the cartridge expense store and supplies cartridges to 3, removing empty cartridge cylinder.

No. 7 attends outside the shell expense store, fixes fuzes, brings up and places projectile in the breech on loading tray, removing shot bearer.

To Prepare for Action and Examine Gun.

Group Officer.

Gun Captain.

*"Prepare for action and
examine Gun."*

*"Prepare for action.
Examine Gun."*

At "Prepare for action" each number brings up his stores† as under—

Gun Layer.—Gun, mirror, and shield sights as ordered, tubes, two lanyards (cocking and firing), rimer, tube extractor, percussion lock and spare strikers (for drill purposes a drill tube).

No. 2.—Side arms (consisting of sponge, rammer, and scraper with brush) and loading tray or trays.

No. 3.—Key for muzzle tampon (if used), indicator and spanner, oil can, Russian tallow and waste.

No. 4.—Assists 2 with side arms and loading tray or trays.

No. 5.—Handle of lowering pump and assists 7.

No. 6.—Bucket filled and brush (for drill purposes a cartridge case or cylinder with drill cartridge).

No. 7.—Shot bearer, brush, two selvagees, fuzes, fuze and shell implements and piece of chalk (for drill purposes a drill shell).

The stores having been brought up and found correct, the covering plates will be removed by the detachment, the Gun Captain will then give "Examine Gun" and sec—

That the automatic cut off gear is in adjustment and in good order.‡

That the holding down clips or bolts are disconnected.

That the roller path is clean.

He will attach the indicator, test the pressure in cylinder, and test level of liquid.§

He will receive the fuze key from 7.

He receives reports from the numbers responsible of any irregularity or deficiency in connection with the different parts of the gun, mounting, and stores.

When firing by P.F. he sees that the firing plug is ready for use and the electric lanyard attached to the proper binding screws.

* This will be only necessary when using brown powders.

† Some of these stores may be already on the gun.

‡ This must be noted when the gun is in the firing position.

§ For method of charging and testing cylinders vide pp. 14, 17, 21-33.

As soon as the breech has been opened by 2 and 3, he looks through the bore and sees that it is clear.

When firing by electricity he will be responsible that the firing battery and wires are correct and ready for use. (See page 82).

The Gun Layer receives the tubes from the shell store, coils up the lanyards, placing them with the extractor, rimer and tubes, in a recess or other convenient position in the emplacement or mounting, and having examined the lock places it in position in the breech-block. He then fires a tube,* sees that the lock is in good working order and rimes out the vent.

When P.F. is used he coils up the electric lanyard and places it in the firing plug box clear of the detachment.

He fixes the gun sights in the gun, taking care that the fore-sights fit properly, and the deflection leaves of the hind-sights work easily. He places the mirrors, when used, in their frames, being careful to observe that they are properly secured by the spring clips, and that the wires are adjusted to agree with the tangent sight; he also fixes the shield sights and sees that the pointer for training arc is let down to position for reading training. He then takes up his position under cover.

No. 2 arranges side arms and sees that the traversing gear is oiled and in working order, and disconnects the holding down clip or bolt on his own side.

No. 3 removes muzzle tampion and breech apron and disconnects the holding down clip or bolt on his own side.

No. 4 assists 2 to arrange side arms and sees that the elevating gear is oiled and in good working order.

Nos. 5 and 7 place the stores they have brought up in a convenient position for use. At drill the drill shell is to be placed outside the shell expense store.

No. 6 places bucket of water and brush near head of side arms, also loosens or removes bands from covers of cylinders, as required, if not already done. At drill he places the cartridge case or cylinder with drill cartridge outside cartridge expense store.

The breech will then be opened by 2 and 3.

Opening and Closing the Breech.

Nos. 2 and 3 will then open the breech as follows:—3 releases the spring catch of lever with his right hand, and raises the lever to its full extent, then with both hands gives it a sharp pull towards him till hard against the stop, and folds the lever down; 2 then takes hold of handle of breech-block with both hands, withdraws breech-block and swings it sharply round on its carrier ring to spring latch on side of gun; 2 then examines the breech-block and sees that it is clean and the threads free from burrs, lubricating them with a slight film of oil and rubbing the asbestos pad with Russian tallow or grease; 3 examines the bore, chamber, and threads of breech, also lubricating the threads with a slight film of oil if necessary.

"To close the breech."—3 raises the cam-lever with his right hand, 2 presses down the spring latch retaining the carrier ring, swings the breech-block round and pushes it home with both hands, holding it there† until 3 locks it by forcing the lever from him as far as it will go, 3 then folds down the lever securing it by its catch in the hood.

* N.B.—Before firing the tube, the Gun Captain will see that no one is in front of the muzzle.

† 2 must be careful to keep his hands clear of the stop on carrier ring as the breech-block is turned round.

After each number has completed his work as above he goes under cover.

The position of the various numbers under cover is as follows. They should then, if possible, be sitting or lying down.*

Gun Captain.—Where he can best regain his position for superintending the working of the gun.

Gun Layer.—In line with the breech of the gun on the right side.

2 and 4 on the right side of the gun; 3 on the left.

2 and 3 being next the muzzle, and 4 outside 2.

5 and 7 outside the shell expense store.

6 outside the cartridge expense store.

But they may be locally arranged otherwise so long as the men know exactly where to go, and are near enough to spring rapidly to their work.

To Load.

Group Officer.

".... *Group or Gun.*"
† ".... *Load.*"

Gun Captain.

".... *Gun.*"
† ".... *Load.*"

The Gun Layer adjusts his tangent sight approximately to the range shown on the indicator dial or other means of passing the ranges, or as ordered by the Group Officer, as the case may be, and to the deflection given by the Group Officer.

When P.F. is used he does not touch the tangent sight, but connects up the electric lanyard to a tube.

2 and 3 open the breech (if it has been closed after examining the gun) as before detailed; 3 places the loading tray, supplied by 4, in breech.

5 and 7 bring up the projectile and lift it in line with the bore; if using time fuze the Gun Captain will set it; 3 removes safety pin or pins from or uncaps the fuze and pushes the projectile on to loading tray.

4 supplies rammer to 2, who, assisted by 3, rams the projectile well home. 2 springs the rammer and hands it to 4 who replaces it.

6 supplies cartridges in case or cylinder to 3, who places them in chamber and removes the shalloon patch from the end of last cartridge, withdraws the loading tray and hands it to 4. The breech is then closed by 2 and 3, 4 replacing the loading tray. The Gun Layer then puts a tube in the vent.†

NOTE.—When using Q.E. and mirror sights, and firing by percussion tubes, the cocking and firing lanyards will be attached before the gun is run up, lanyards being passed and allowed to hang over the shield, care being taken that they cannot possibly catch as the gun is run up.

To Run Up.

Group Officer.

"*Run up.*"

Gun Captain.

"*Stand clear.*" "*Run up.*"

* It is permitted at the option of the Instructor for the detachment to be standing or sitting down when at drill.

† "Palliser," "Common," "Case," or "Shrapnel," as the case may be, the Group Officer giving the nature and length of fuze if required.

‡ The tube is never to be inserted before the breech is properly closed under any pretext whatever.

No. 5 presses down lever of raising valve as far as it will go towards "open," and lets go the lever. He permits the gun to rise until he hears a click* in the interior of the cylinder, which tells him that the gun is fully up. He then completes the closing of the valve by raising the lever as far as it will go.

NOTE.—When P.F. is used, the Gun Layer puts in the electric tube before running up, and takes care that the lanyard is clear of the mounting, so as not to be cut when the gun recoils.

Making Ready, Elevating and Traversing.†

As soon as the gun has been run up, the Gun Layer mounts on to the laying step, hooks one lanyard‡ to the firing bolt and the other to the hammer of the percussion lock and throws them over the shield in rear of breech of gun, being careful to see that the guide bolt of the lock is home in the cam groove, and proceeds to lay his gun.

2 and 3 man the traversing wheels, 4 the elevating wheel.§

The Gun Layer gives directions to elevating and traversing numbers by word of command or signal.

If Q.E. is used, the Gun Captain directs the elevating number.

LAYING AND FIRING.

Case I.

I.—When elevation and direction are given by tangent scale; or when straight-edged sights and Q.E. are used.

The Gun Layer lays his gun with the deflection ordered and the elevation as shown on indicator dials or other means provided for passing ranges, or as ordered by the Group Officer, altering it now and then as the dial or other means alter, or as ordered by the Group Officer as the case may be, or 4 elevates or depresses to the elevation ordered by the Gun Captain who reads the Q.E., until the final range is given as follows:—

Final Range.	
Group Officer.	Gun Captain.
" Gun."	" Gun."
" Yards, LAY."	" Yards, LAY."

At the order "lay" the Gun Layer adjusts the tangent scale to the exact elevation named, or 4 gives the elevation ordered.

NOTE.—If the gun is to be fired as soon as possible after being loaded, the Group Officer should give the final range immediately the gun is run up.

When firing at a stationary target, the Gun Layer as soon as he has received the final range and laid his gun, jumps down and goes under cover, the elevating and traversing Nos. doing the same, until the Group Officer gives the order, ". Group or No. Gun Commence Firing."

* This click is caused by the end of the ram coming against the top of the cylinder.

† Note.—The gun may be roughly traversed into the line of fire, before or during running up, by 2 and 3 under the direction of the Gun Layer looking over the shield sights.

‡ The lanyard hook for all percussion locks is to be inserted point downwards.

§ With B.L. guns, mounted on H.P. mountings, the last motion of the elevating gear should be "elevation" and not "depression."

Commence Firing.

<u>Group Officer.</u>	<u>Gun Captain.</u>
	(On seeing that the Gun Layer has descended the ladder and is clear of the recoil.)
" . . . Gun."	" . . . Gun."
" Commence Firing."	" Fire."

At the order "*Commence Firing*," the Gun Layer rapidly makes any final correction of the laying that may be necessary, cocks the lock, and comes down from the laying steps, noting that these are clear of the recoil. As soon as the Gun Layer has descended the ladder and is clear, 4 seizes the firing lanyard,* and on the order "*Fire*," from the Gun Captain, fires. 2 and 3 remain on the traversing wheels until the gun is fired.

NOTE.—In case of a miss-fire (*i.e.*, the tube not being fired), 4 will recock the lock with the cocking lanyard; on another miss-fire, the tube should be extracted and the lock examined by the Gun Layer.

In the event of a tube firing but failing to ignite a charge, after a pause of a minute the tube must be extracted by the Gun Layer, and another one inserted.

Under no circumstances should the breech be opened with a tube in the vent.

Case II.

II.—When using mirror sights and Q.E.

The Gun Layer keeps the gun trained on the target by looking in the lower mirror, laying only for direction.

4 elevates or depresses to the elevation ordered under the direction of the Gun Captain, who reads the Q.E.

"The "*elevation ordered*" will be that shown on the indicator dial or other means of exhibiting ranges, or as ordered by the Group Officer, as the case may be.

Final Range.

<u>Group Officer.</u>	<u>Gun Captain.</u>
" . . . Gun."	" . . . Gun."
" . . . Yards, LAY."	" . . . Yards, LAY."

At the order "*Lay*," the final elevation ordered is given by direction of the Gun Captain, 4 seizes the lanyards, cocking the lock by means of the cocking lanyard. (For Electric Firing, see page 82.)

Commence Firing.

<u>Group Officer.</u>	<u>Gun Captain.</u>
" . . . Gun."	(On getting signal from Gun Layer.)
" Commence Firing."	" . . . Gun."
	" Fire."

* For Electric Firing, see page 82.

At the order "*Commence Firing*," the Gun Layer will rapidly make any final correction of the laying, and hold up his right hand over his head when on the target; 4 fires the gun on the order "*Fire*" from the Gun Captain.

2 and 3 remain on the traversing wheels until the gun is fired.

Case III.

III.—*With quadrant elevation and training arc.*

The Gun Captain directs 4 to elevate or depress as in Case II., except that when P.F. is used, the elevation will be that called by the dial number.

The Gun Layer reads the training by pointer, as given by Group Officer or otherwise (or with P.F., by the dial number), and directs the traversing numbers as required.

Final range.

At the order from the Group Officer or "dial number," "*Range . . . yards, Training . . . degrees, Lay*," 4 gives the exact elevation called out, directed by the Gun Captain, and goes under cover, unless when firing is not with P.F., when 4 proceeds as in Case II.

The Gun Layer, with the help of 2 and 3, gives the exact training, and goes under cover, 2 and 3 remaining on the traversing wheels.

Commence Firing.

The Gun Captain satisfies himself that the gun is laid on the proper target.

If P.F. is not used, the words of command will be as in Case II., and 4 will fire on the Gun Captain giving the word.

When firing by P.F., the Gun Captain puts in the firing plug and runs to the rear of the pit, or where he can best be seen by the Group Officer, holding up his hand in line with his shoulder.

N.B.—He must, however, communicate with the Group Officer, if he cannot be seen by him, by word of mouth, signal, or as may be most convenient.*

When the Group Officer gives to the dial number the word or signal "*Commence Firing*," he goes under cover.

Scraping and Sponging Out.

As soon as the gun is fired, the Gun Captain removes the firing plug if P.F. is used, 2 and 3 open the breech, the Gun Layer unhooks the lanyards, extracts the old tube and rimes out the vent (with P.F. coils up the electric lanyard and puts it in the firing plug box); when using brown powder, 4 supplies the scraper with brush to 3, and if necessary the sponge (wetted) to 2.

3 scrapes and brushes out the residue from the previous round, being careful that the threads in the breech are not choked with it.

If necessary, 2 then sponges out, taking the same precautions; 4 replaces the scraper and sponge.

* Should a fresh prediction be necessary, or the signal or order "*Standfast*" be given before the Group Officer orders "*Commence Firing*," the Gun Captain will immediately remove the firing plug, and the service of the gun will continue as before.

To Run Back and Unload at Drill.

As soon as the gun has been fired, the Gun Captain gives the order to "*Run Back.*"

5 ships* the handle of lowering pump and, assisted by 2 and 3, "*Runs back.*" As soon as the gun is down, the Gun Captain gives the word "*Halt.*" 5 unships the handle of lowering pump and replaces it.

2 and 3 open the breech; 3 withdraws cartridges and places them in case or cylinder; 2 takes hold of lanyard of drill shell and pulls it steadily out of the chamber far enough for the selvage to be placed over it by 5 and 7, who remove and replace it.

As soon as the gun is unloaded 4 supplies 3 with scraper, and 3 scrapes and brushes out the chamber.

To Cease Firing and Replace Stores.

Group Officer.

"*Cease Firing and Replace Stores.*"

Gun Captain.

"*Cease Firing and Replace Stores.*"

The stores are returned by the numbers who brought them up.

The Gun Captain sees that the holding-down clips or bolts have been connected, and that the raising lever is secured by chain and padlock.

After replacing stores the detachment falls in two deep in rear of the gun, as at first.

"To take Post under Cover."

"To form Detachment Rear."

These movements will be required at times. They will be as follows:—

To take Post under Cover.

Group Officer.

"*Take Post under Cover.*"

Gun Captain.

"*Double March.*"

Each number doubles to his position as given on page 70.

To form Detachment Rear.

Group Officer.

"*Detachment Rear.*"

Gun Captain.

"*Double March.*"

The Gun Captain doubles out and places himself on the left rear of the mounting, facing to the front. On the word "*Double March,*" the numbers double to their places in "*Detachment Rear,*" halting and fronting as they come up.

* If not already there.

DRILL FOR 6-INCH B.L. GUN ON VAVASSEUR MOUNTING. Gun Detachment.

The gun detachment consists of a Gun Captain (No. 1), a Gun Layer, and 6 other gun numbers.

The detail for falling in and telling off a detachment is the same as for 6-inch B.L. on H.P. mounting.

Position of Detachment when Marched to their Guns.

The detachment is then moved into the work, and halted facing the mounting and to the rear of it.

If more than one gun of a group is being manned, each Gun Captain marches his detachment to his gun as above, or to such other convenient position under cover as the Group Officer may direct.

N.B.—When drilling by single guns without a Group Officer, the directions, cautions, and commands laid down in this drill to be given by the Group Officer, will be given by the Gun Captain.

General Duties.

"The Gun Captain" * (No. 1) commands, and is responsible to the Group Officer for the regular and efficient service of the gun in all respects.†

When at practice he is responsible to the Group Officer that his gun is laid on the target ordered.

When his gun is fought by position finder he will insert the firing plug after the gun laid.

Reads and gives Q.E. to elevating number.

When time fuzes are employed he sets them.

Gun layer.—His special duty is the laying of the gun.

When direction is given by training arc, he reads the training and directs (by signal) the traversing numbers.

He attends to the vent and percussion lock and makes ready.

No. 2 withdraws and cleans breech-block, rams home, inserts breech-block, traverses and sponges if necessary.

No. 3 unlocks cam-lever, places loading tray, uncaps fuze or removes safety pin or pins, loads, removes shalloon patch from end of last cartridge, rams home, removes loading tray, locks cam-lever, traverses, removes residue from chamber and mushroom head with scraper and brush after every round.‡

No. 4 supplies side arms and loading tray, elevates and fires.

No. 5 assists 7 in all his duties.

No. 6 attends outside the cartridge expense store and supplies cartridges to 3, removing empty cartridge case or cylinder.

No. 7 attends outside the shell expense store, fixes fuzes, brings up and places projectile in the breech on loading tray, removing shell bearer.

* It is recommended that, when feasible, this non-commissioned officer should have permanent charge of the gun, and be responsible for its condition and cleanliness, and all stores, &c., connected with it, and also for the emplacement in which it is mounted.

† When Q.E. is used, or training by arc and pointer, he must especially see that the numbers concerned are exact in their work.

‡ This will only be necessary when using brown powders.

To Prepare for Action and Examine Gun.

<p><u>Group Officer.</u></p> <p><i>"Prepare for action and examine Gun."</i></p>		<p><u>Gun Captain.</u></p> <p><i>"Prepare for action." "Examine Gun."</i></p>
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At "*Prepare for Action*," each number brings up his stores* as under:—

Gun Layer.—Sights, tubes, two lanyards (cocking and firing), rimer, extractor, percussion lock, and spare strikers (for drill purposes a dummy tube).

No. 2.—Side arms (consisting of sponge, rammer, scraper, and brush) and loading tray or trays.

No. 3.—Key for muzzle tampeon, and oil can, Russian tallow and waste.

No. 4.—Elevating wheel, and assists 2 with side arms and loading tray or trays.

Nos. 5 and 7.—Wooden shell bearer, brush, two selvagees, fuzes, fuze and shell implements, and piece of chalk (for drill purposes a drill shell).

No. 6.—Bucket filled and brush (for drill purposes a cartridge case or cylinder with drill cartridge).

The stores having been brought up and found correct, the covering plates will be removed by the detachment; the Gun Captain will give "*Examine Gun*," and see—

That the fuzes and fuze implements have been brought up and are ready to his hand.

That the hydraulic buffers are properly filled and adjusted.

He will receive the fuze key from 7.

He receives reports from the numbers responsible of any irregularity or deficiency in connection with the different parts of the gun, mounting, and stores.

As soon as the breech has been opened by 2 and 3, he looks through the bore and sees that it is clear.

When firing by P.F. he sees that the firing plug is ready for use, and the lanyard attached to the proper binding screws.

When firing by electricity he will be responsible that the firing battery and wires are correct and ready for use.

The Gun Layer receives the tube from the shell store, coils up the lanyards, placing them with the extractor, rimer and tubes in a recess or other convenient position in the emplacement or mounting, and having examined the lock (percussion or electric), he places it in position in the breech-block. He then fires a tube,† sees that the lock is in good working order, and rimes out the vent.

When P.F. is used he coils up the electric lanyard and places it in the firing plug box clear of the detachment.

He fixes the sights in the gun, taking care that the fore-sights fit properly, and the deflection leaves of the hind-sights work easily. He then takes up his position under cover.

* Some of these stores may be already on the gun.

† N.B.—Before firing the tube the Gun Captain will see that no one is in front of the muzzle.

No. 2 arranges side arms and sees that the traversing gear is oiled and in working order.

No. 3 removes muzzle tampon and breech apron.

No. 4 puts on elevating wheel, and assists 2 to arrange side arms, and sees that the elevating gear is oiled and in good working order.

Nos. 5 and 7 place the stores they have brought up in a convenient position for use. At drill the drill shell is to be placed outside the shell expense store.

No. 6 places bucket of water and brush near head of side arms, also loosens or removes bands from covers of cylinders, as required, if not already done. At drill he places the cartridge case or cylinder with drill cartridge outside cartridge expense store.

The breech will then be opened by 2 and 3.

Opening and Closing the Breech.

As with 6-inch B.L. on H.P. mounting.

After each number has completed his work as above he goes under cover.

The position of the various numbers under cover is as with 6-inch B.L. on H.P. mounting.

To Load.

Group Officer.

Gun Captain.

" Group or Gun."
* " Load."

" Gun."
* " Load."

The Gun Layer adjusts his tangent sight approximately to the range shown on the indicator dial or other means of passing the ranges, or as ordered by the Group Officer, as the case may be, and to the deflection given by the Group Officer.

When P.F. is used, he does not touch the tangent sight, but connects up the electric lanyard to a tube.

2 and 3 open the breech (if it has been closed after examining the gun) as before detailed; 3 places the loading tray, supplied by 4, in breech.

5 and 7 bring up the projectile and lift it in line with the bore; if using time fuze the Gun Captain will set it; 3 removes safety pin or pins from or uncaps the fuze and pushes the projectile on to loading tray.

4 supplies rammer to 2, who, assisted by 3, rams the projectile well home; 2 springs the rammer and hands it to 4, who replaces it.

6 supplies cartridges in case or cylinder to 3, who places them in chamber, and removes shalloon patch from the end of last cartridge, withdraws the loading tray, and hands it to 4. The breech is then closed by 2 and 3, 4 replacing the loading tray.

Making Ready, Elevating, and Traversing.

As soon as the breech has been closed the Gun Layer puts a tube in the vent,† hocks one lanyard‡ to the firing bolt, and the other to the

* "Palliser," "Common," "Case," or "Shrapnel," as the case may be, the Group Officer giving the nature and length of time fuze if required.

† The tube is never to be inserted before the breech is properly closed under any pretext whatever.

‡ The lanyard hook for all percussion locks is to be inserted point downwards.

hammer of the percussion lock, and allows them to hang in rear of the gun, being careful to note that the guide bolt of the lock is home in the cam groove. He then proceeds to lay his gun.

When P.F. is used, he puts in the electric tube, and takes care that the lanyard is clear of the slide, so as not to be cut by gun carriage on recoil.

2 and 3 man the traversing handles; 4 the elevating wheel.

The Gun Layer gives directions to the elevating numbers in a low tone when tangent scales are used, but when Q.E. is used and the elevating numbers cannot read it, the Gun Captain signals to them as follows:—

"Elevate."—He holds up either hand, fingers pointing upwards.

"Depress."—He turns his hand, so that the fingers point downwards.

"Halt."—He slaps his thigh.

For direction, the Gun Layer gives the following signals* to the traversing number:—

"Trail Right or Left."—He motions with his hand, his fingers pointing in the required direction, so as to be best seen by the traversing numbers.

"Halt."—He slaps his thigh.

Laying and Firing.

Case I.

I.—When elevation and direction are given by tangent scale.

The Gun Layer lays his gun with the deflection ordered, and the elevation as shown on indicator dials or other means provided for passing ranges or as ordered by the Group Officer, altering it now and then as the dial or other means alter, or as ordered by Group Officer, as the case may be, until the final range is given as follows:—

Final Range.

Group Officer.

"..... Group."

or

"..... Gun."

"..... Yards LAY."

Gun Captain.

"No. Gun."

"..... Yards LAY."

At the order "LAY," the Gun Layers, or only that of the gun named, as the case may be, adjust the tangent sight to the exact elevation ordered.

NOTE.—If a gun or guns of a group are to be fired as soon as possible after being loaded, the Group Officer should give the final range immediately the loading is completed.

When firing at a stationary target the Gun Layer as soon as he has received the final range and laid his gun jumps down and goes under cover, the elevating and traversing numbers doing the same until the Group Officer gives the order. . . . "Group or No. . . . Gun Commence Firing."

* In some cases the traversing Nos. may be unable to see the signals, in such cases the Gun Layer will direct them by word of command.

Commence Firing.

<u>Group Officer.</u>	<u>Gun Captain.</u>
"..... Group."	(on seeing Gun Layer step clear)
or "..... Gun."	"..... Gun,
"Commence Firing."	Fire."

At the order "*Commence Firing*," the Gun Layers of the group or of the gun named will make any final correction of the laying that may be necessary, cock the locks, and step clear.

As soon as the Gun Layer is clear, 4 seizes the lanyard,* and on the order "*Fire*" from the Gun Captain, fires; 2 and 3 remain on the traversing handles until the gun is fired.

NOTE.—In case of a miss-fire (*i.e.*, the tube not being fired), 4 will re-cock the lock with cocking lanyard. On another miss-fire the tube should be extracted, and the lock examined by the Gun Layer.

In the event of a tube firing but failing to ignite a charge, after a pause of a minute the tube must be extracted by the Gun Layer, and another one inserted.

Under no circumstances should the breech be opened with a tube in it.

Case II.

II.—When using straight edged sights,† and quadrant elevation.

The Gun Layer having cocked the lock,‡ stands clear of the recoil and keeps his gun trained on the target, laying only for direction.

4 elevates or depresses to the elevation ordered by the Gun Captain reading the quadrant elevation, unless means are provided which he can read himself, when he will take it from such means.

The "elevation ordered" will be that shown on the indicator dial, or other means of exhibiting ranges, or as ordered by the Group Officer, as the case may be. (For Electric Firing, see page 82.)

Final Range.

<u>Group Officer.</u>	<u>Gun Captain.</u>
"..... Group."	"..... Gun."
or	
"..... Gun."	"..... yards LAY."
"..... yards LAY."	

At the order "*Lay*," 4 carefully gives the final elevation ordered, and then seizes the lanyard and stretches it taut.

Commence Firing.

<u>Group Officer.</u>	<u>Gun Captain.</u>
"..... Group."	(On getting signal from Gun Layer.)
or	
"..... Gun."	"..... Gun."
"Commence Firing."	Fire."

* For Electric Firing, see page 82.

† During the loading the Gun Layer will have set the target scale at the approximate range; it may be necessary, however, for him to further alter it in order that the target may be in the field of the straight edge.

‡ With an A percussion lock the Gun Layer will cock the lock after placing in the tube.

At the order "*Commence Firing*," the Gun Layer will rapidly make any final correction of the laying, and hold up his right hand over his head when on the target; 4 fires the gun on the order "*Fire*" from the Gun Captain.

2 and 3 remain on the traversing handles until the gun is fired.

Case III.

III.—*With quadrant elevation and training arc.*

4 elevates or depresses as in Case II, except that when P.F. is used he gives the elevation as called by the dial number, directed if necessary by the Gun Captain.

The Gun Layer reads the training by pointer as given by Group Officer or otherwise (with P.F. by the dial number), and directs the traversing numbers as required.

Final Range.

At the order from the Group Officer or "dial number" "*Range* yards. *Training* degrees, *Lay*," 4 gives the exact elevation called out (directed, if necessary, by the Gun Captain) and goes under cover; unless when firing is not with P.F., when 4 seizes the lanyard or connects up wire to firing battery. The Gun Layer, with the help of 2 and 3, gives the exact training and goes under cover; 2 and 3 remaining on the handles.

Commence Firing.

The Gun Captain satisfies himself that the gun is laid on the proper target.

If P.F. is not used, the words of command will be as in Case II, and 4 will fire on the Gun Captain giving the word.

Firing with P.F.

But when firing by P.F., the Gun Captain puts in the firing plug and runs to the rear of the mounting, where he can best be seen by the Group Officer, holding up his hand in line with his shoulder; he must, however, inform the Group Officer, if he cannot be seen by him, by word of mouth, signal, or as may be most convenient.*

When the Group Officer gives to the dial number the word or signal "*Commence Firing*," he goes under cover.

Scraping and Sponging Out.

As soon as the gun is fired the Gun Captain removes the firing plug, if P.F. is used, 2 and 3 open the breech, the Gun Layer unhooks the lanyards, extracts the old tube and rimes out the vent (with P.F. coils

* Should a fresh prediction be necessary or the signal or order "*Standfast*" be given before the Group Officer orders "*Commence firing*," the Gun Captain will immediately remove the firing plug, and the service of the gun will continue as before.

up the lairyard and puts it in the firing plug box); when using brown powder, 4 supplies the scraper with brush to 3, and, if necessary, the sponge (wetted) to 2.

3 scrapes and brushes out the residue left from the previous round, being careful that the threads in the breech are not choked with it.

If necessary, 2, assisted by 3, sponges out, taking the same precautions; 4 replaces the scraper and sponge.

To Unload at Drill.

As with 6-inch B.L. on H.P. mounting.

To Cease Firing and Replace Stores.

Group Officer.

"..... Group."
"Cease Firing and Replace
Stores."

Gun Captain.

..... Gun
Cease Firing and Replace
Stores."

The Gun Captain sees that 4 depresses till the gun is at an angle of about 4°. The stores are replaced by the numbers who brought them up. After replacing stores, the detachment falls in two deep in rear of the mounting, as at first.

To Take Post under Cover and Form Detachment Rear.

As at 6-inch B.L., H.P.

DRILL FOR 6-INCH B.L. GUN ON BARBETTE MOUNTING.

Gun Detachment.

To Tell Off.

Similar to 6-inch B.L. on H.P. mounting.

General Duties.

The Gun Captain* (No. 1) commands, and is responsible to the Group Officer for the regular and efficient service of the gun in all respects.†

* It is recommended that, when feasible, this non-commissioned officer should have permanent charge of the gun, and be responsible for its condition and cleanliness, and all stores, &c., connected with it, and also for the emplacement in which it is mounted.

† When Q.E. is used, or training by arc and pointer, he must especially see that the numbers concerned are exact in their work.

When at practice he is responsible to the Group Officer that his gun is laid on the target ordered.

When his gun is fought by position finder he will insert the firing plug after the gun is laid.

Reads and gives quadrant elevation (Q.E.) to elevating number.

When time fuzes are employed he sets them.

Gun Layer.—His special duty is the laying of the gun.

When direction is given by training arc, he reads the training and directs the traversing numbers.

He attends to the vent and percussion lock and makes ready.

No. 2 withdraws and cleans breech-block, assists to load, rams home, inserts breech-block, traverses, and sponges (if necessary).

No. 3 unlocks breech-block, places loading tray, uncaps fuze or removes safety pin or pins, loads, removes shalloon patch from end of last cartridge, rams home, removes loading tray, locks breech-block, elevates and removes residue from chamber and mushroom head with scraper and brush, after every round.

No. 4 supplies side arms and loading tray, runs up and fires.

No. 5 assists 7 in all his duties.

No. 6 attends outside the cartridge expense store and supplies cartridges to 3, removing empty cartridge case or cylinder.

No. 7 attends outside the shell expense store, fixes fuzes, brings up and places projectile on loading stage, removes shell bearer.

To Prepare for Action and Examine Gun.

Group Officer.

*"Prepare for action and
examine Gun."*

*"Prepare for action."
"Examine Gun."*

At *"Prepare for action"* each number brings up his stores* as under:—

Gun Layer.—Sights, tubes, two lanyards (cocking and firing), rimer, tube extractor, percussion lock, and spare strikers (for drill purposes a drill tube).

No. 2.—Side arms (consisting of sponge, rammer, scraper with brush) and loading tray or trays and traversing wheels.

No. 3.—Key for muzzle tampeon, oil can, Russian tallow and waste, and elevating wheels.

No. 4.—Assists 2 with side arms and loading tray or trays.

No. 5.—Assists 7.

No. 6.—Bucket filled and brush (for drill purposes a cartridge case or cylinder with drill cartridges).

No. 7.—Shot bearer, brush, two selvagees, fuzes, fuze and shell implements and piece of chalk (for drill purposes a drill shell), and two sets of gun tackles.

The stores having been brought up and found correct, the Gun Captain will give *"Examine gun"* and sec—

* Some of these stores may be already on the gun.

* That the preventor gear is in adjustment, and in good working order.

That the clip plates are secured to the carriage; that the hydraulic buffer is properly filled; that the roller path is clean; and that the carriage is run back and kept in position by preventor gear.

He will receive the fuze key from 7.

He receives reports from the numbers responsible of any irregularity or deficiency in connection with the different parts of the gun, mounting, and stores.

When firing by P.F. he sees that the firing plug is ready for use and the electric lanyard attached to the proper binding screws.

As soon as the breech has been opened by 2 and 3, he looks through the bore and sees that it is clear.

When firing by electricity he will be responsible that the firing battery and wires are correct and ready for use. (See page 82.)

The Gun Layer receives the tubes from the shell store, coils up the lanyards, placing them with the extractor, rimer and tubes in a recess or other convenient position in the emplacement or mounting, and, having examined the lock places it in position in the breech-block. He then fires a tube,† sees that the lock is in good working order, and rimes out the vent.

When P.F. is used he coils up the electric lanyard and places it in the firing plug box clear of the detachment.

He fixes the sights in the gun, taking care that the fore-sights fit properly, and the deflection leaves of the hind-sights work easily. The training arc is let down to position for reading training. He then takes up his position under cover.

No. 2 arranges side arms, puts on traversing wheels, and sees that the traversing gear is oiled and in working order.

No. 3 puts on elevating wheels, sees that elevating gear is oiled and in good working order, removes muzzle tampon and breech apron.

No. 4 assists 2 to arrange side arms, and sees that the running up gear is oiled and in good working order.

Nos. 5 and 7 place the stores they have brought up in a convenient position for use. At drill the drill shell is to be placed outside the shell expense store.

No. 6 places bucket of water and brush near head of side arms, also loosens or removes bands from covers of cylinders, as required, if not already done. At drill he places the cartridge case or cylinder with drill cartridge outside cartridge expense store.

The breech will then be opened by 2 and 3.

Opening and Closing the Breech.

Similar to 6-inch B.L. on H.P. Mounting.

After each number has completed his work as above he goes under cover.

The position of the various numbers under cover is as follows. They should then, if possible, be sitting or lying down.

Gun Captain.—Where he can best regain his position for superintending the working of the gun.

* This must be noted when the gun is in the loading position.

† N.B.—Before firing the tube, the Gun Captain will see that no one is in front of the muzzle.

Gun Layer.—In rear of mounting.
 2 on the right side of the gun; 3 on the left; 2 and 3 being next the muzzle.
 4 at head of side arms.
 5 and 7 outside the shell expense store.
 6 outside the cartridge expense store.
 But they may be locally arranged otherwise so long as the men know exactly where to go, and are near enough to spring rapidly to their work.

* To Load.

Same as 6-inch B.L. on H.P. mounting, except:—5 and 7 bring up the projectile and place it on the rear of loading stage; if using time fuze the Gun Captain will set it; 3 removes safety pin or uncaps the fuze; 2 and 3 then lift the projectile and place it on the loading tray; 2 casts loose selvagee; 3 hands bearer to 7 and pushes the projectile on to the loading tray.

To Run up.

Group Officer.

Gun Captain.

"Run up."

"Run up."

4 raises the lever of preventor gear, and allows the gun to run up to the firing position.

NOTE.—When P.F. is used the Gun Layer puts in the electric tube before running up, and takes care that the lanyard is clear of the mounting so as not to be cut when the gun recoils.

Making Ready, Elevating and Traversing.

As soon as the gun has been run up, the Gun Layer mounts on to the slide, hooks one lanyard to the firing bolt and the other to the hammer of the percussion lock, being careful to see that the guide bolt of the lock is home in the cam groove, and proceeds to lay his gun.

2 mans the traversing wheel, 3 the elevating wheel.

The Gun Layer gives directions to elevating and traversing numbers by word of command or signal.

If Q.E. is used, the Gun Captain directs the elevating number.

Laying and Firing.

Similar to 6-inch B.L. on Vavasseur mounting, except that No. 3 remains on the elevating wheel till after the gun is fired.

Scraping and Sponging out.

Similar to 6-inch B.L. on H.P. mounting.

To Run Back and Unload. (At Drill.)

At "Run Back," 4 and 5, assisted by 2 and 3, hook the movable blocks to front eyebolts of carriage, and standing blocks to rear eyebolts of slide, and take in the slack. The whole of the numbers, except the Gun Layer, man the falls on their respective sides, and at

* With the 6" on barbette mounting the gun should be loaded after being run up.
 (7282)

"Heave" haul the gun back. When the gun is far enough back, 2, 3, 4, and 5 unhook and overhaul the tackles and place them clear. "To Unload," 2 and 3 open the breech; 3 withdraws cartridges and places them in case or cylinder; 2 takes hold of lanyard of drill shell and pulls it steadily out of the chamber far enough for the selvagee to be placed over it by 3, who also places the bearer; 2 and 3 then remove projectile and place it on rear of loading stage; 5 and 7 remove and replace it.

Cease Firing and Replace Stores.

Similar to 6-inch B.L. on H.P. mounting, except that the Gun Captain will see that the gun is run back and the lever of preventor gear secured by the bolt.

AMMUNITION DETAIL, &c.

In addition to the gun detachments, the following must be provided for according to local requirements: Ammunition supply details, D.R.F., P.F., dial, and telephone details. Orderlies, &c., as required.

FIRING BY ELECTRICITY.

When firing guns by electricity otherwise than with P.F., the Gun Layer when preparing for action will bring up the following stores in addition, viz:—

A Le Clanché battery and firing key in wooden box, and a Menotti battery with galvanometer attached (for testing tubes), or Holden's firing key, which combines both the means of testing and firing.

Two insulated firing wires, each 8 to 10 yards in lengths.

These stores are placed close to the gun, and on one flank or in rear, but as convenient as possible for the firing number, and at the same time so as not to interfere with the working of the gun. The firing wires should be attached, by a turn being taken with them, to a convenient part of the mounting or gun, so that the weight of the wires shall not come on the tube when joined up to it; the other ends are led to the firing battery or key, and one of them attached to a terminal, sufficient slack being allowed for the running up or traversing of the gun. The tube will be joined to the firing wires* by the Gun Layer during the loading of the gun, and placed in the vent as soon as the breech is closed.

The method of firing is similar to that when using percussion tubes, except that in—

Case *L*.—4 connects up the 2nd line wire to the other terminal of

* If a B electric lock is used, one line wire will be attached to the tube, the other line wire to the insulated contact on the breech of the gun, the 2nd tube wire being placed on to the terminal of the lock. (The earth terminal of this lock should be removed.)

the firing battery or key on seeing the firing signal* from the Gun Layer, and presses the firing key on the word "*Fire*" from the Gun Captain.

Cases II and III.—4 connects up the 2nd wire as soon as the Q.E. has been given, and proceeds as in Case I.

As soon as the gun is fired, 4 *at once* disconnects one of the firing wires from the battery or key.

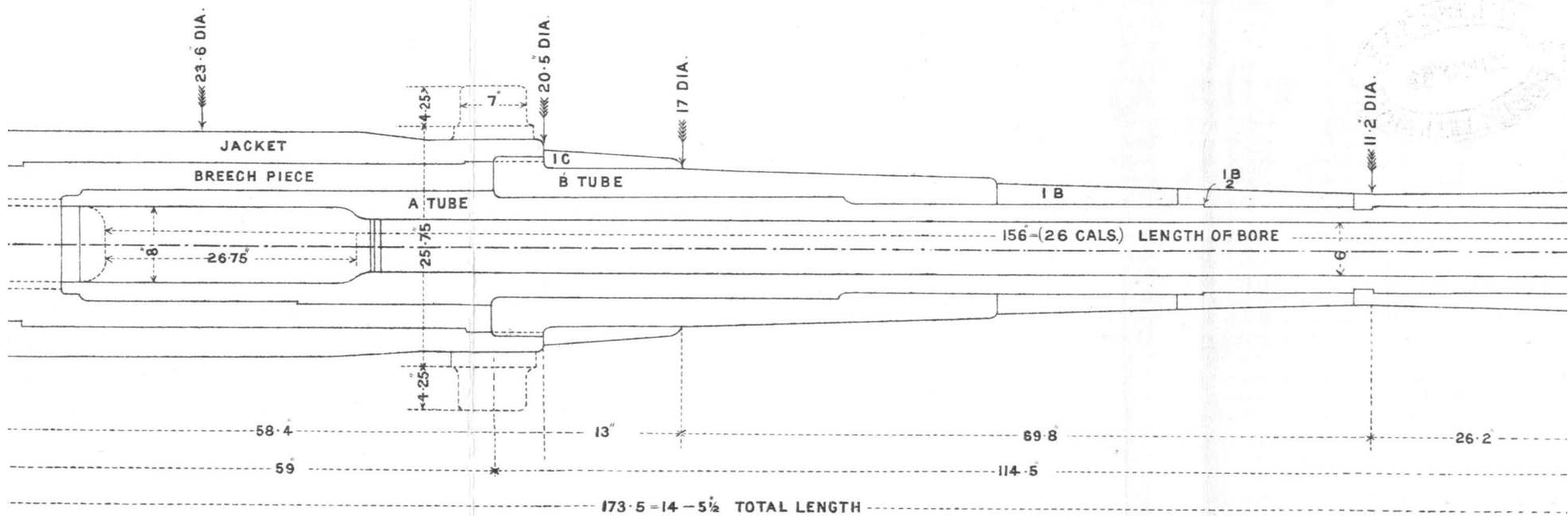
NOTE.—When the tubes are tested before being put into the vent, they should be placed clear of the detachment and in a safe position; if they are tested when in the vent immediately before firing, two or three short lengths of wire will be required in addition to the firing wires when using the Menotti testing battery.

* This signal with H.P. and Vavasseur mountings is the Gun Layer getting clear of the recoil, and with barbette mountings the Gun Layer dismounting from the slide.

ORDNANCE B. L. 6 INCH (MARK IV)

STEEL 5-TON.

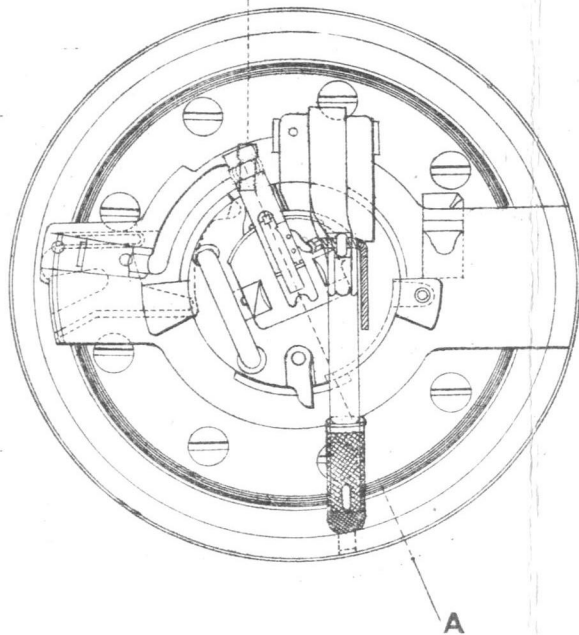
SCALE $\frac{1}{16}$.



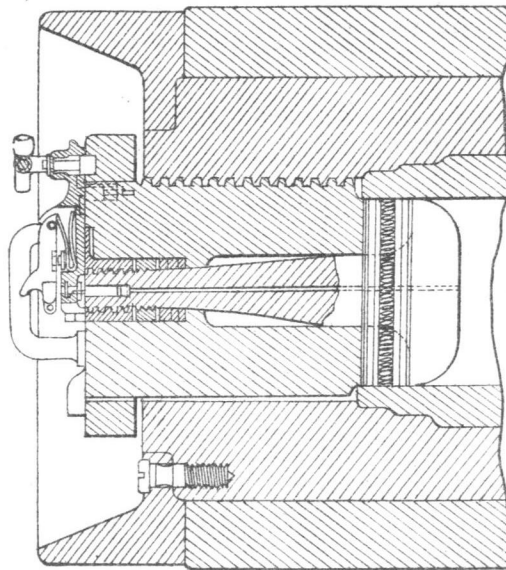
ORDNANCE B.L. 6 INCH MARK IV & VI.

BREECH FITTINGS.

A
BREECH CLOSING ARRANGEMENT
SCALE $\frac{1}{8}$.

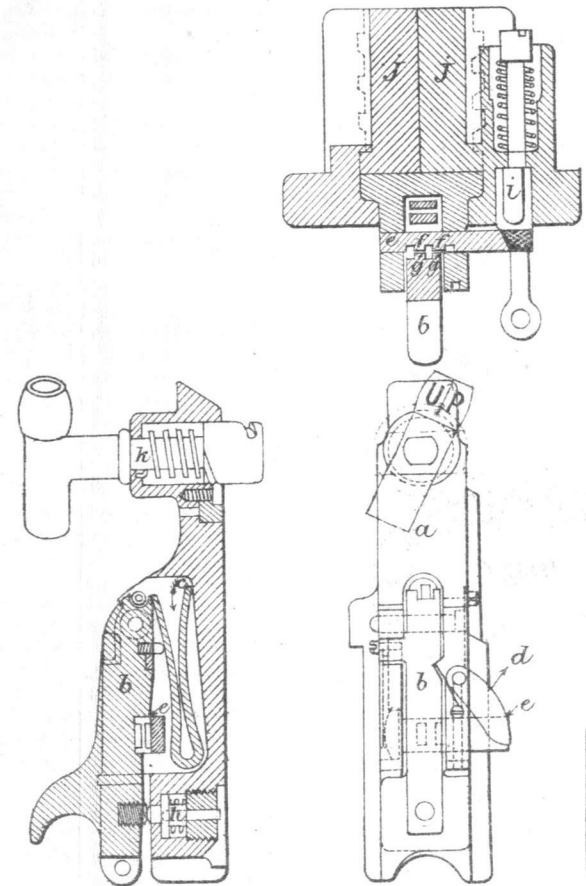


SECTION ON LINE A.A.



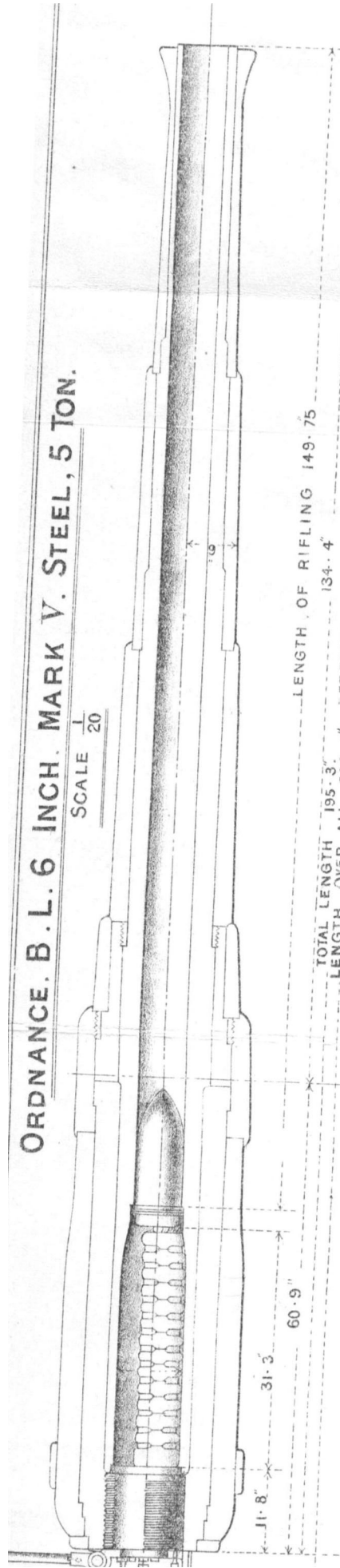
PERCUSSION LOCK

SCALE $\frac{3}{8}$.

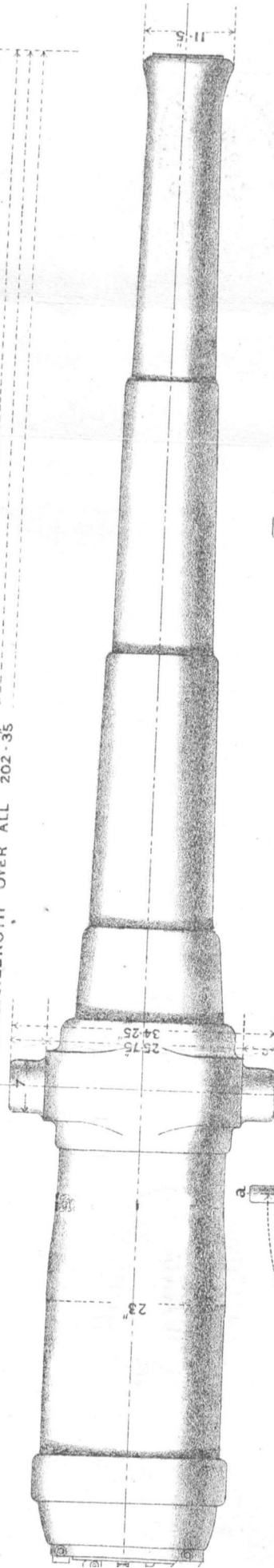


ORDNANCE. B. L. 6 INCH. MARK V. STEEL, 5 TON.

SCALE $\frac{1}{20}$

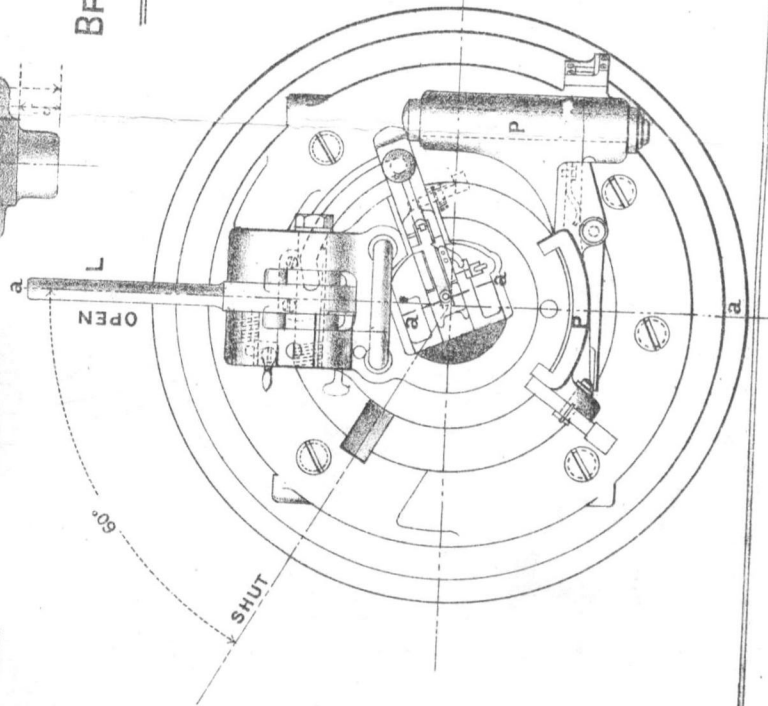


LENGTH OF RIFLING 149.75
TOTAL LENGTH 195.3
LENGTH OVER ALL 202.35

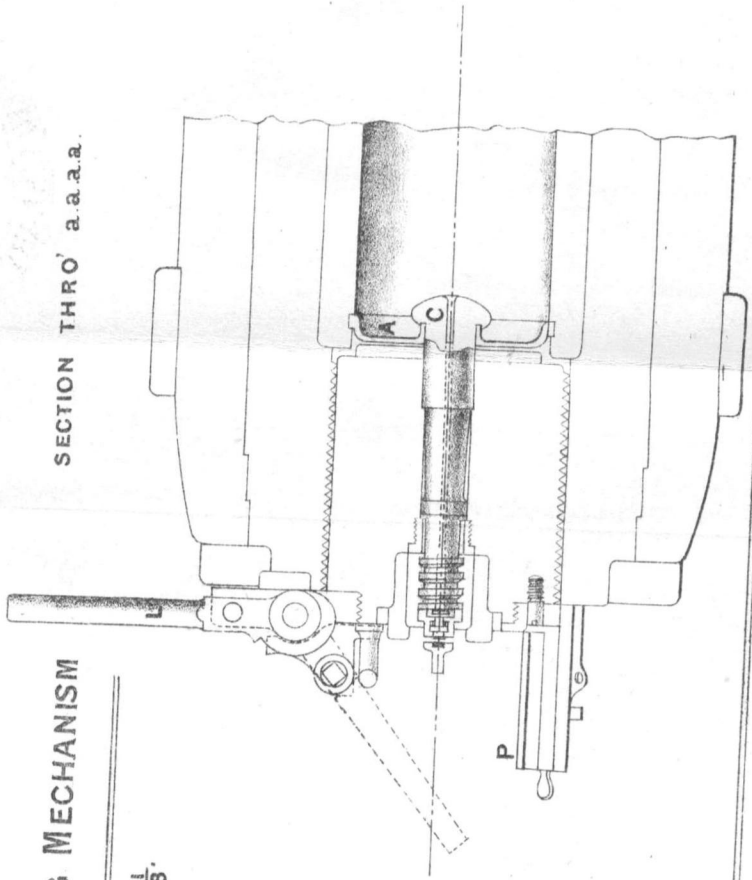


BREECH CLOSING MECHANISM

SCALE $\frac{1}{8}$

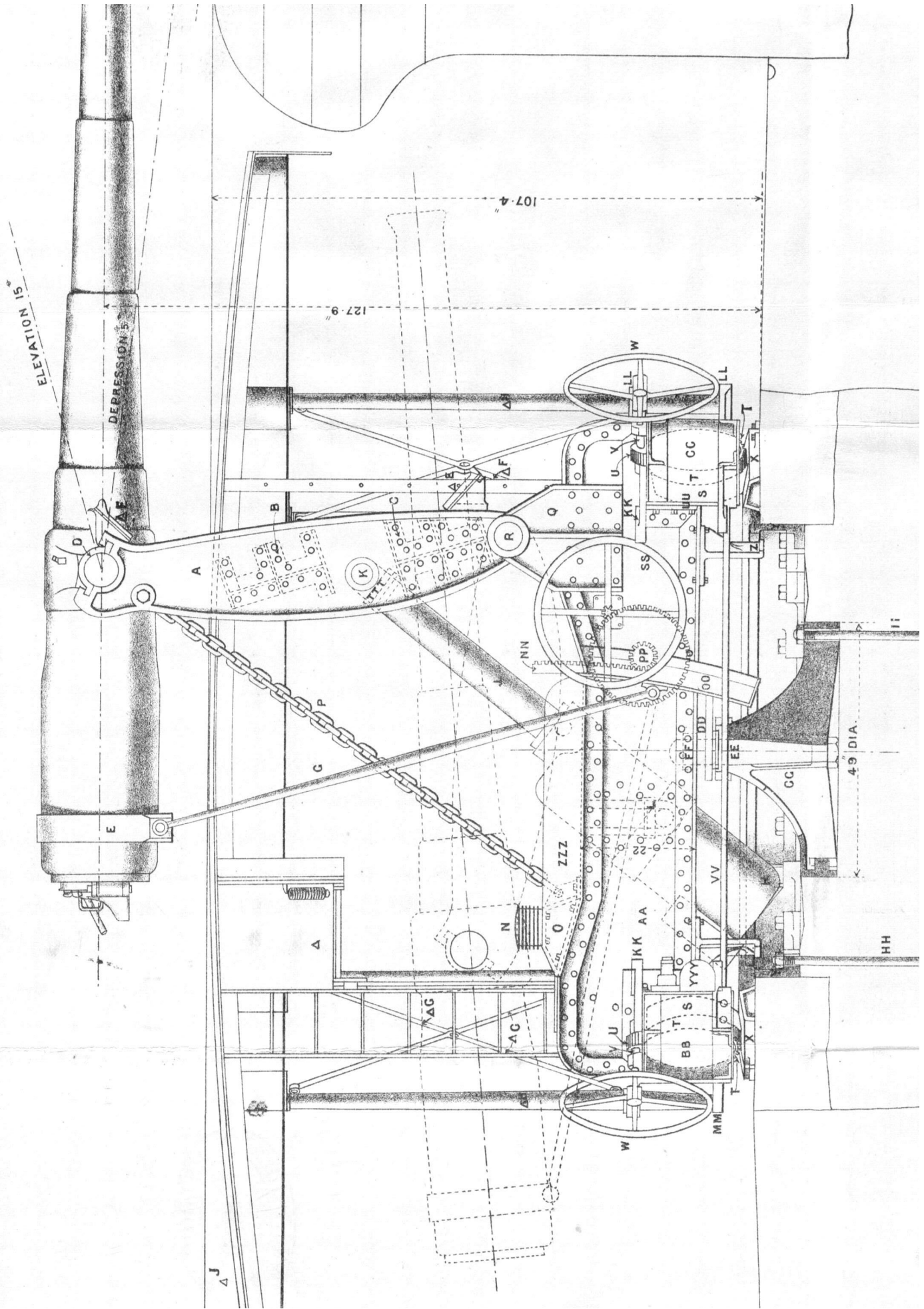


SECTION THRO' a.a.a.a.



SCALE $\frac{1}{25}$.

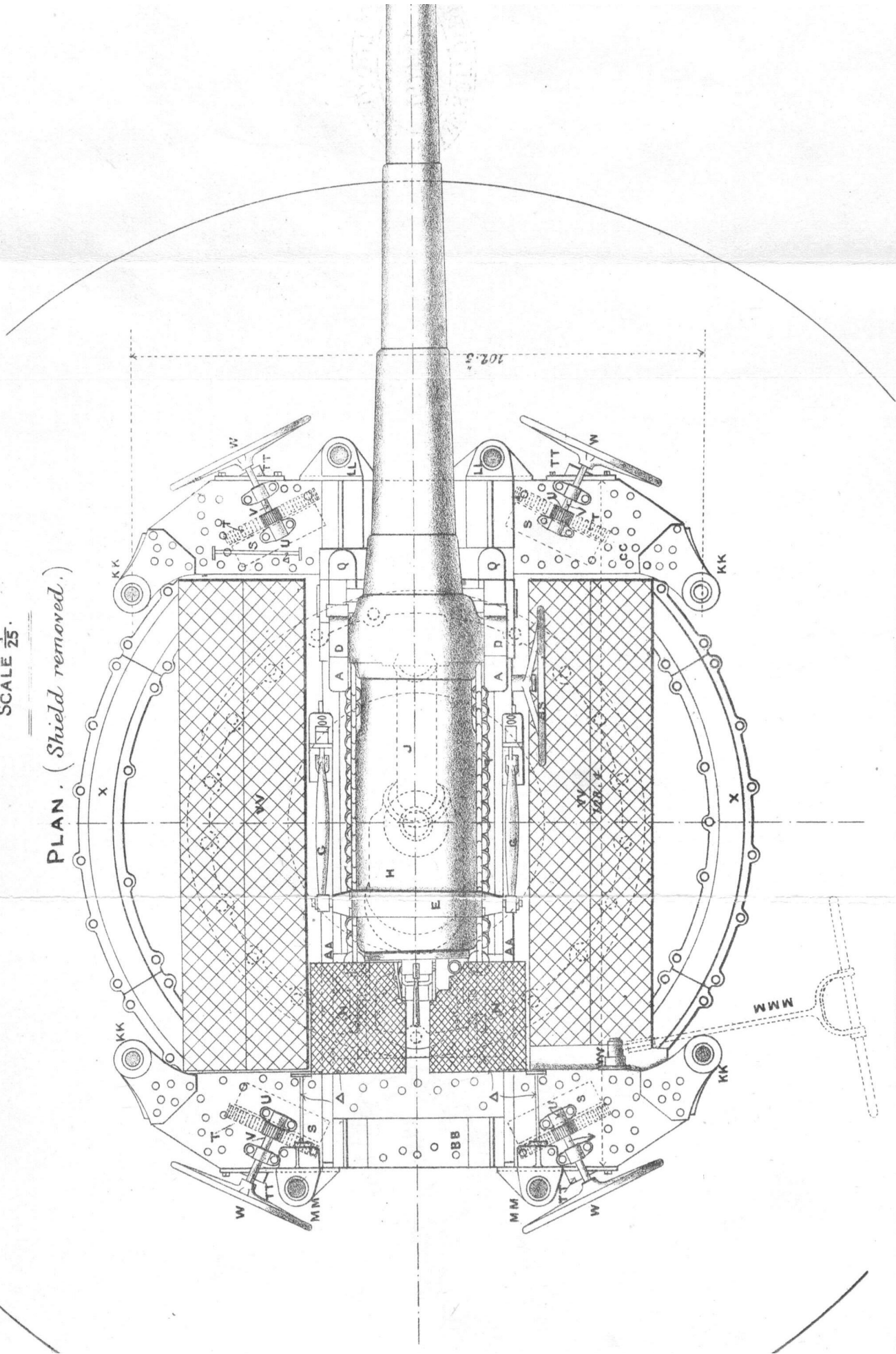
ELEVATION.



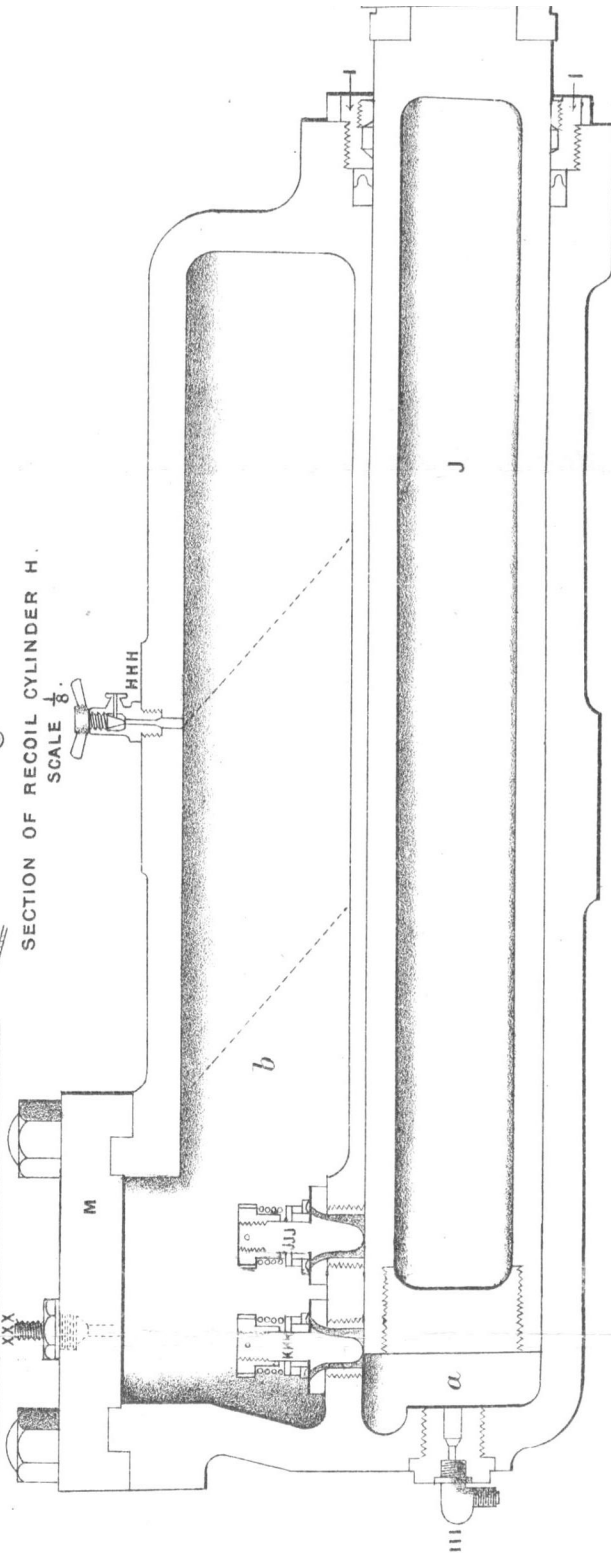
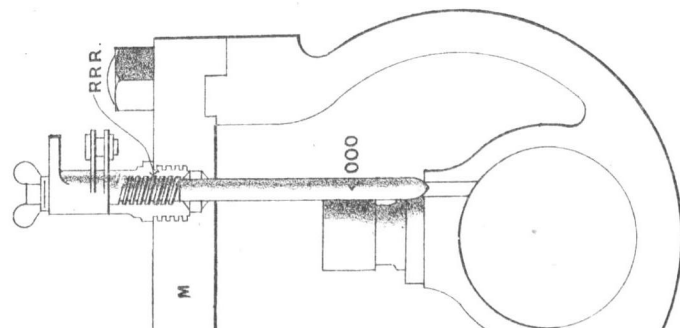
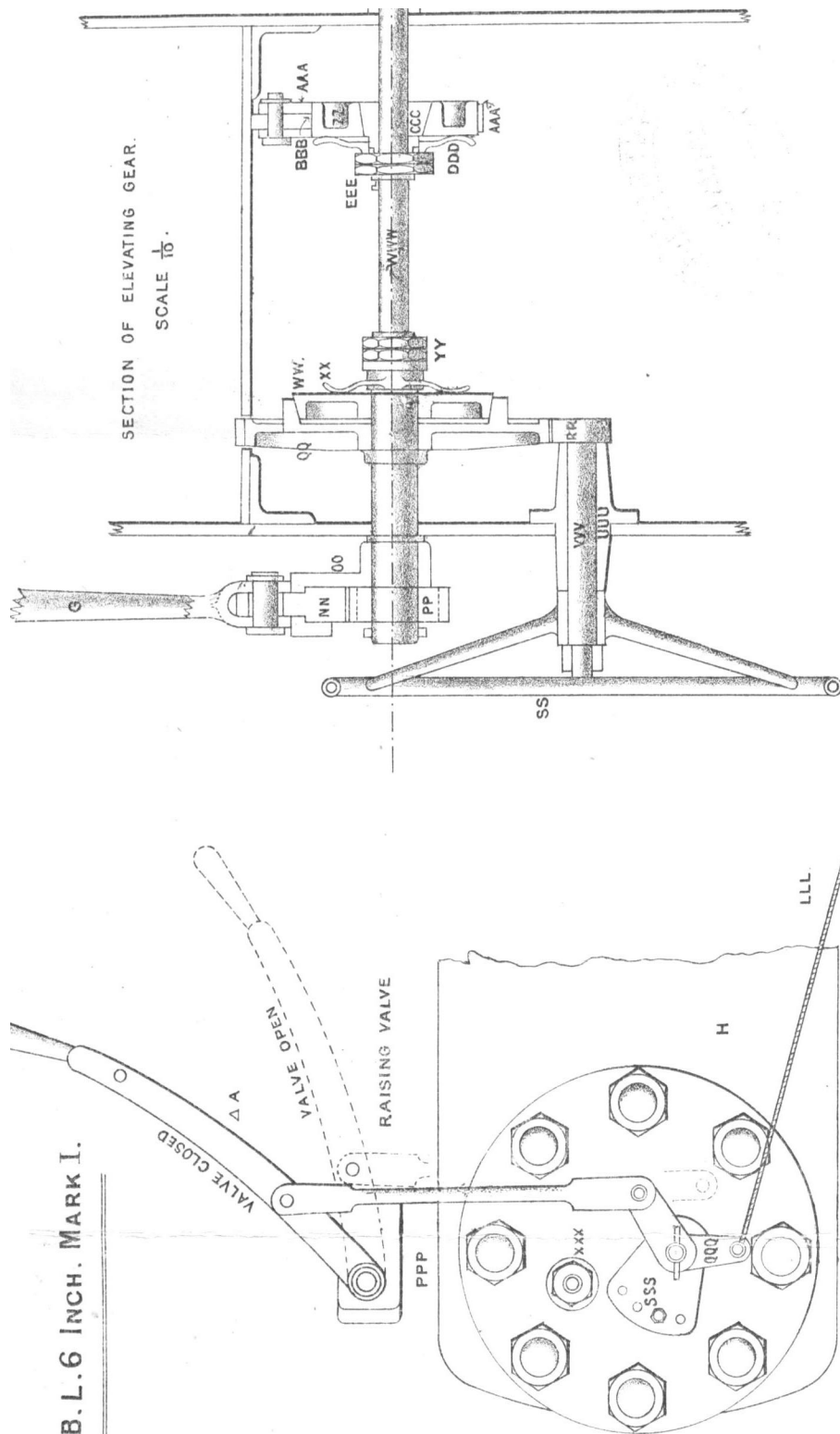
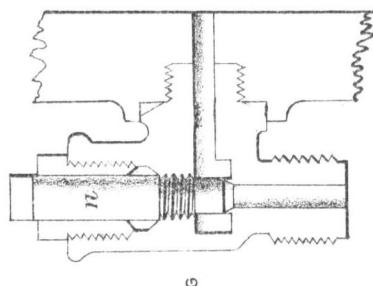
CARRIAGE GARRISON, DISAPPEARING, B. L. 6 INCH. MARK I.

SCALE $\frac{1}{25}$.

PLAN. (Shield removed.)

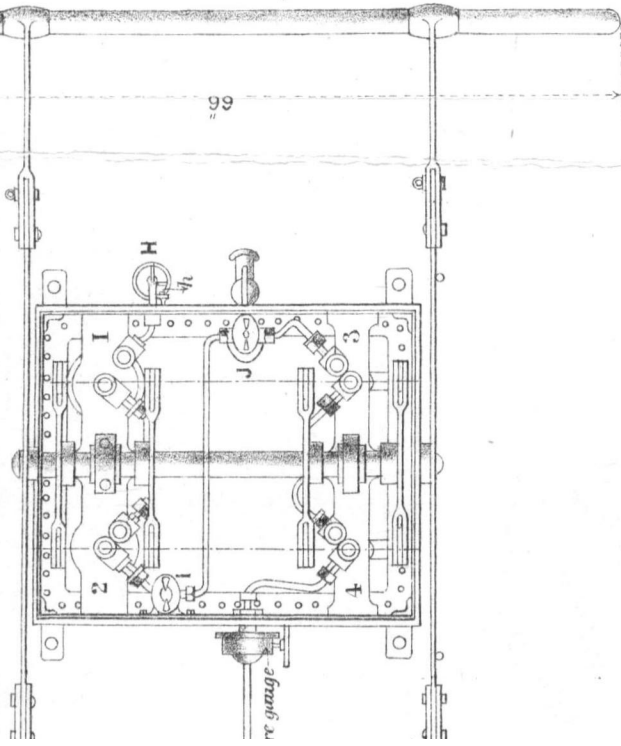


E, CARRISON, DISAPPEARING, B. L. 6 INCH. MARK I.



AIR PUMP.

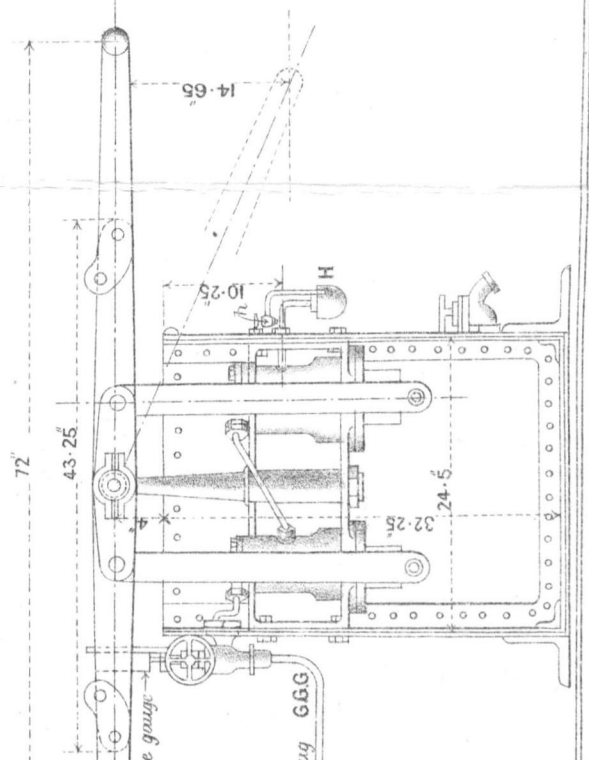
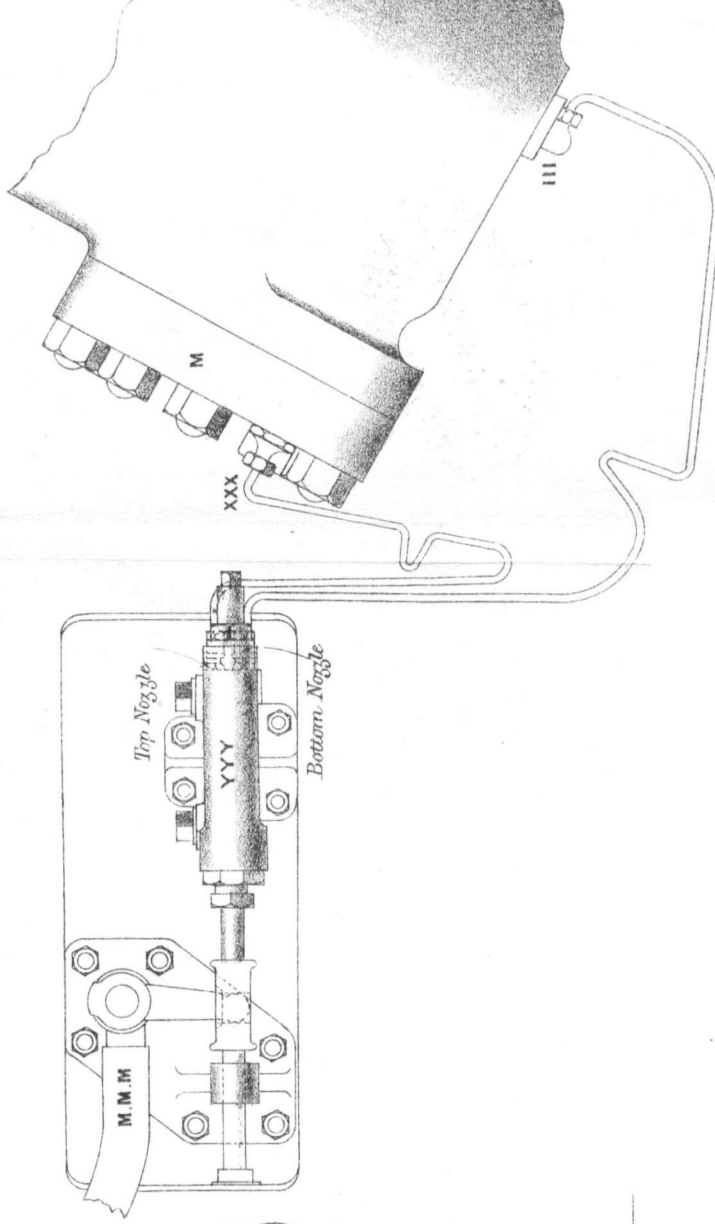
SCALE $\frac{1}{16}$.



CARRIAGE, GARRISON, DISAPPEARING, B. L. 6 INCH. MARK

PIPE CONNECTIONS FOR LOWERING PUMP.

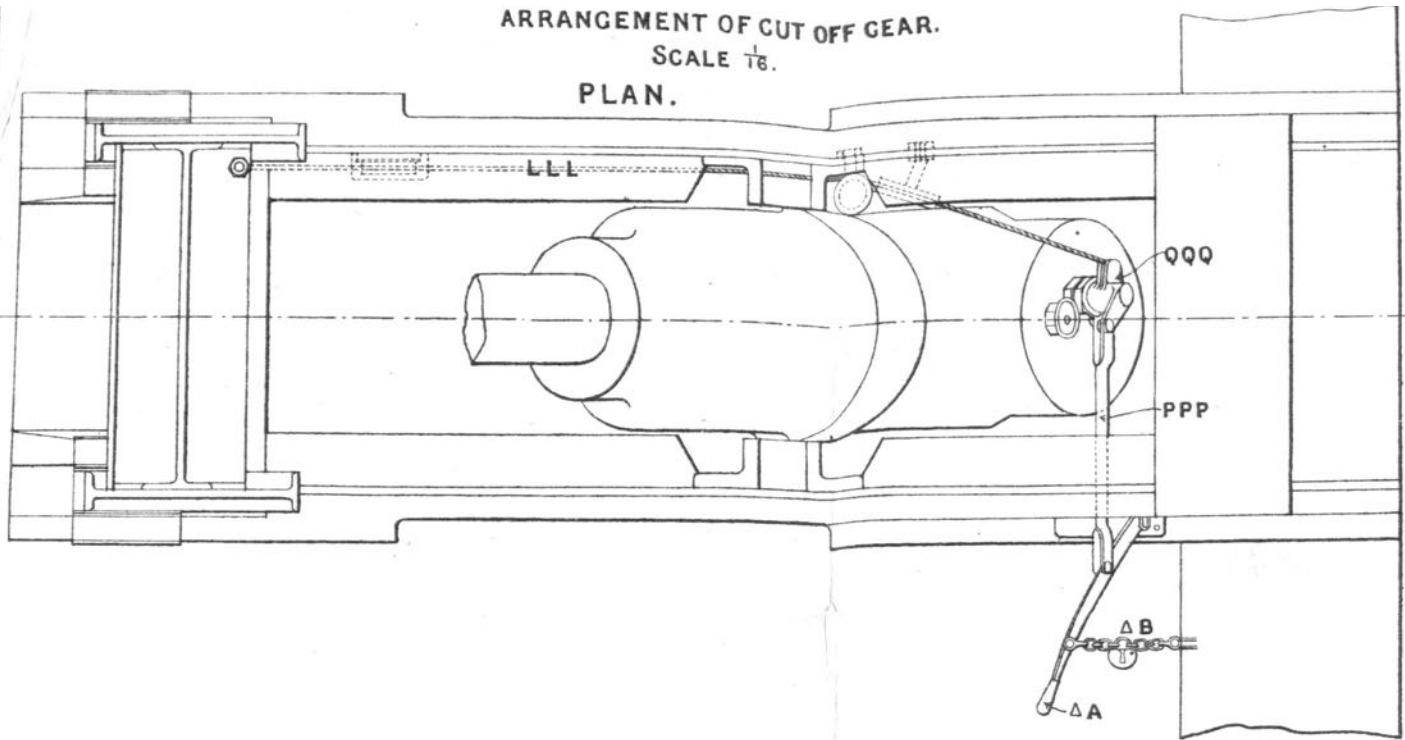
SCALE $\frac{1}{10}$.



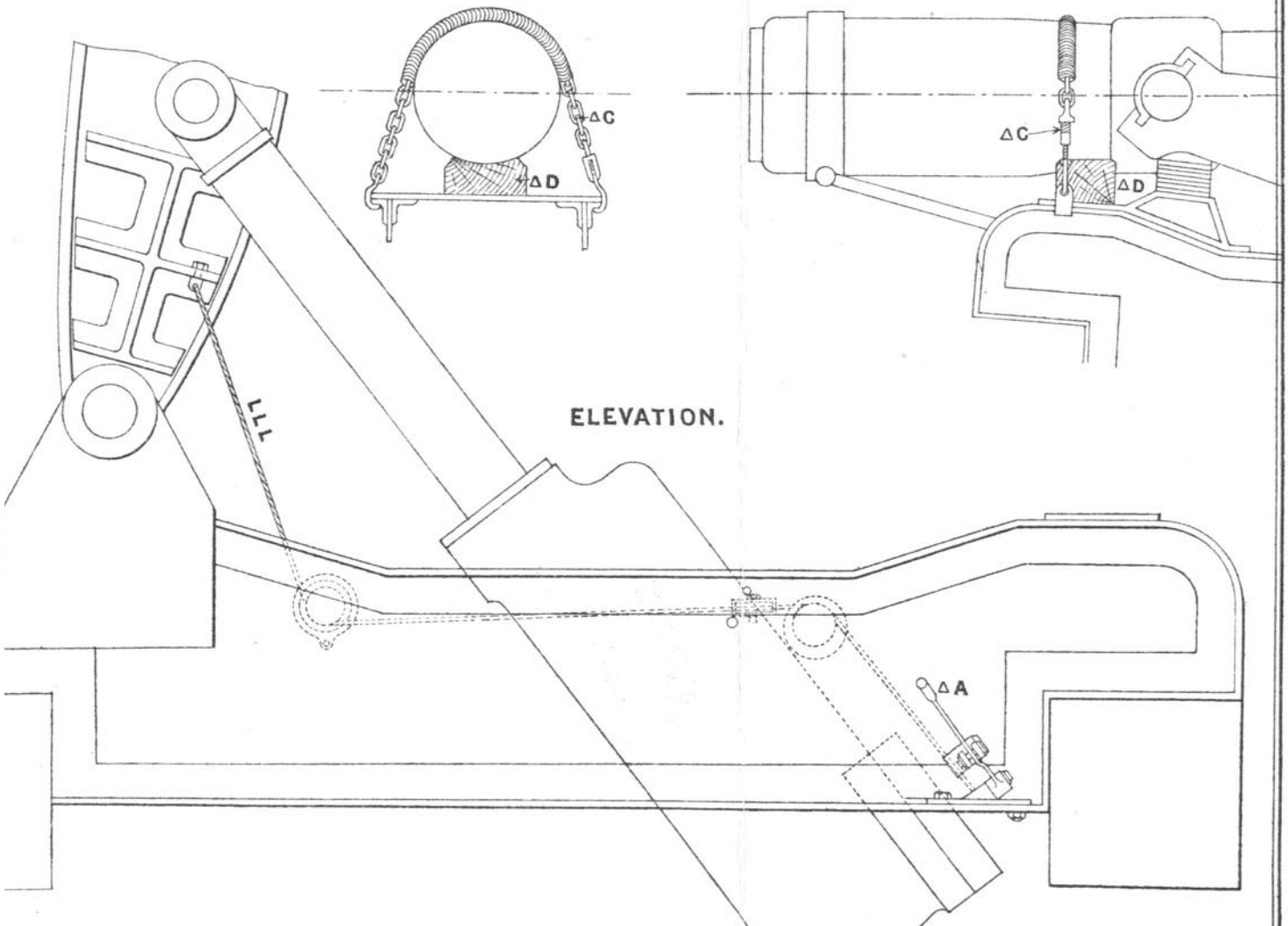
ARRANGEMENT OF CUT OFF GEAR.

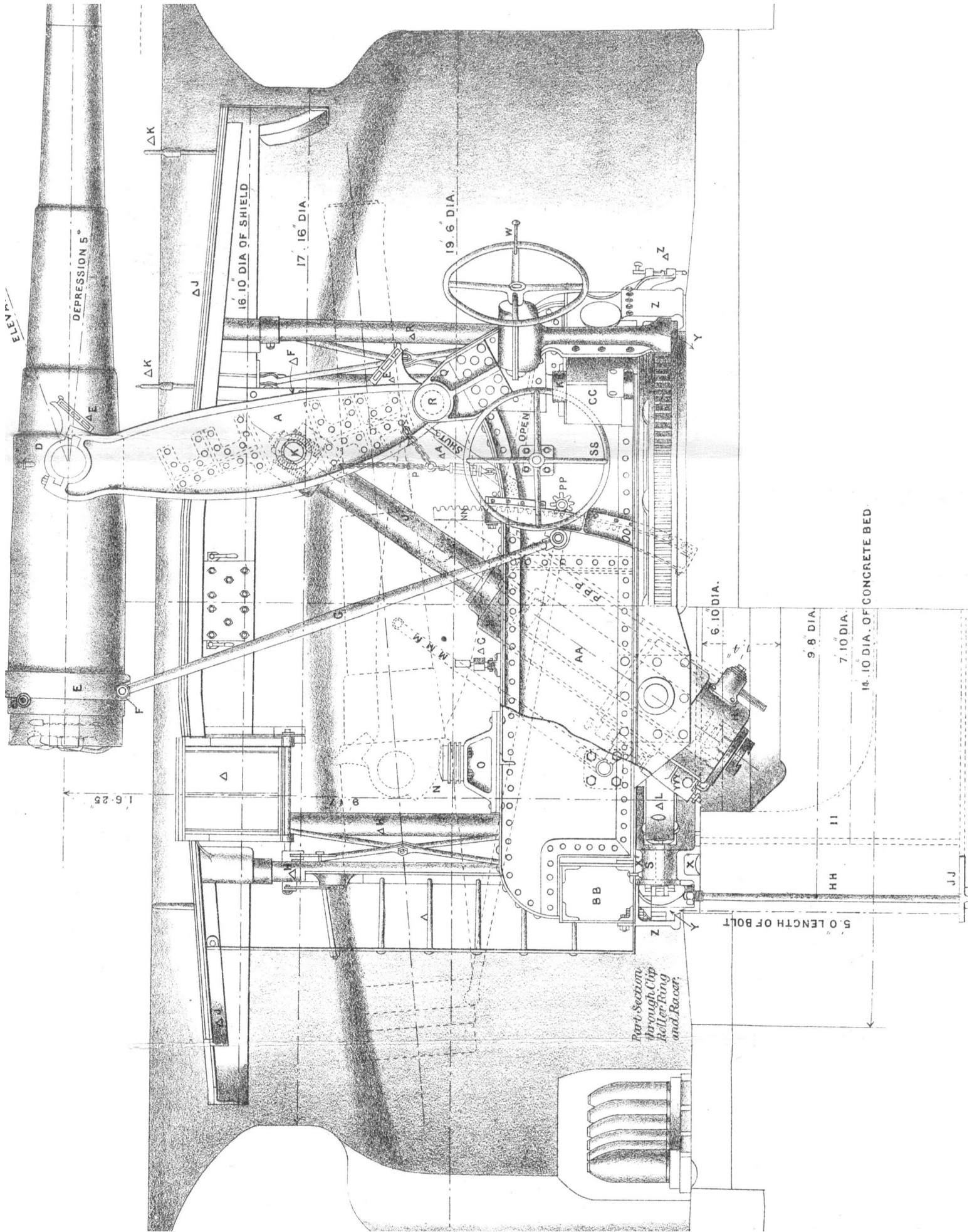
SCALE $\frac{1}{16}$.

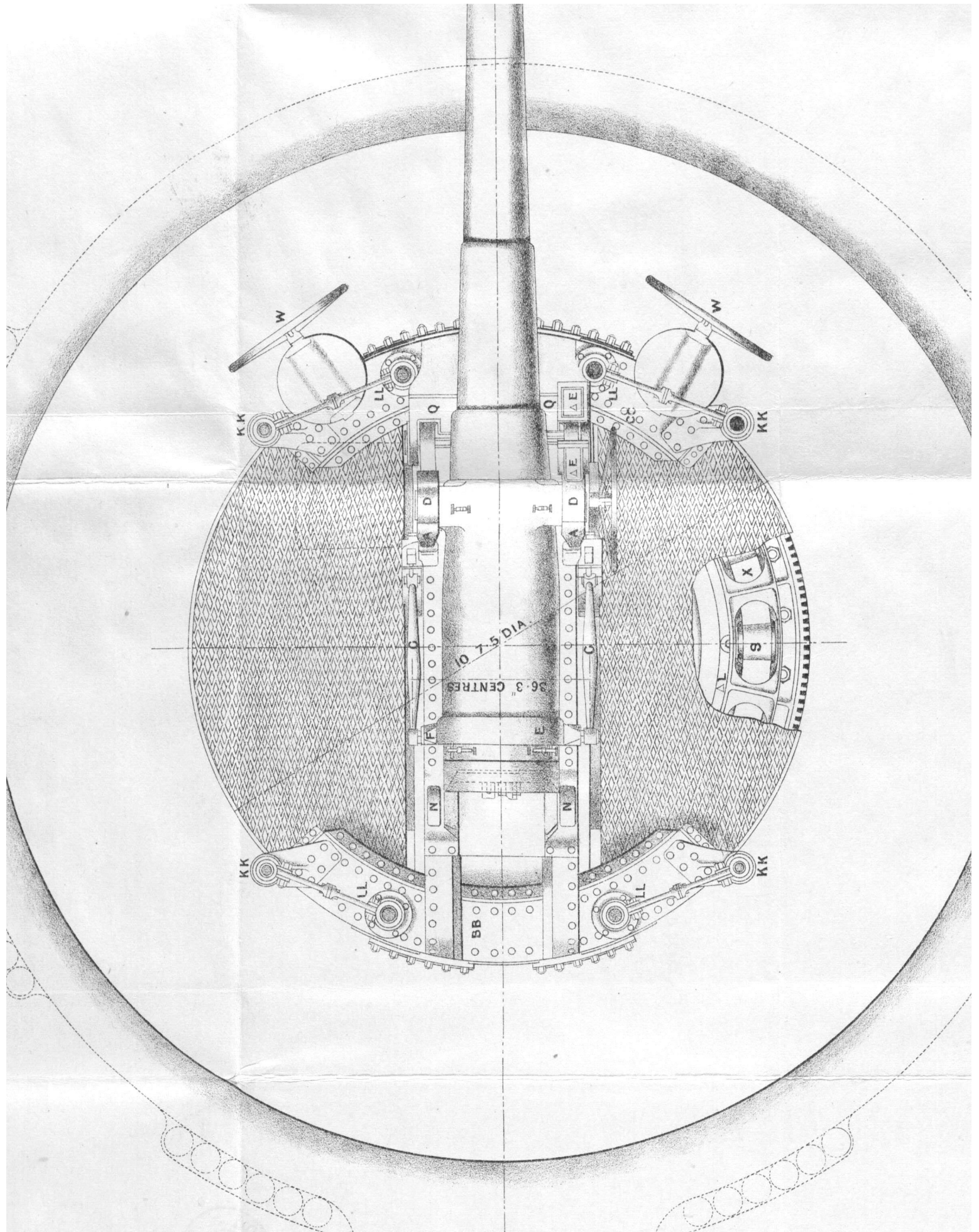
PLAN.



SECURING GEAR

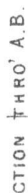






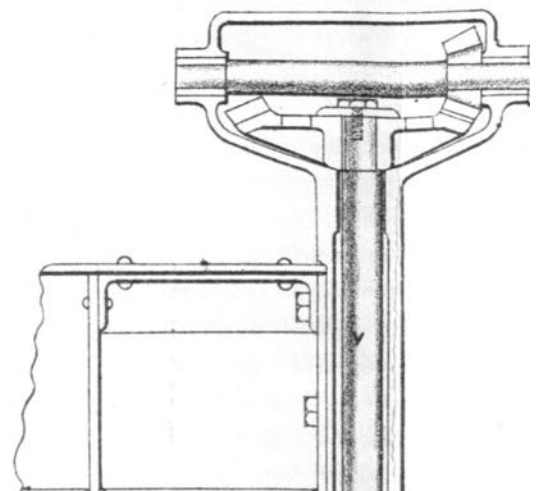
RECOIL CYLINDER H.

SCALE $\frac{1}{10}$.

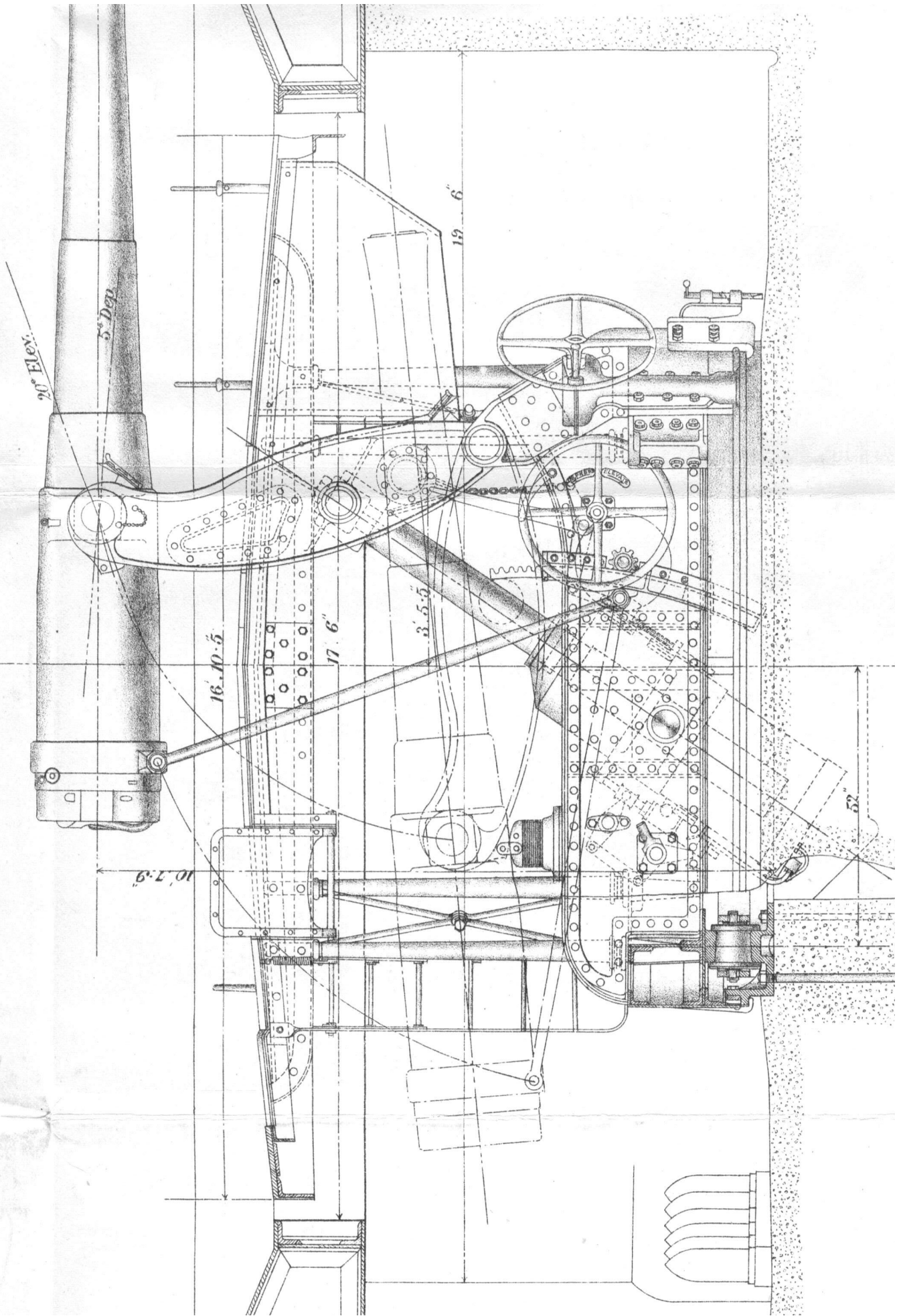




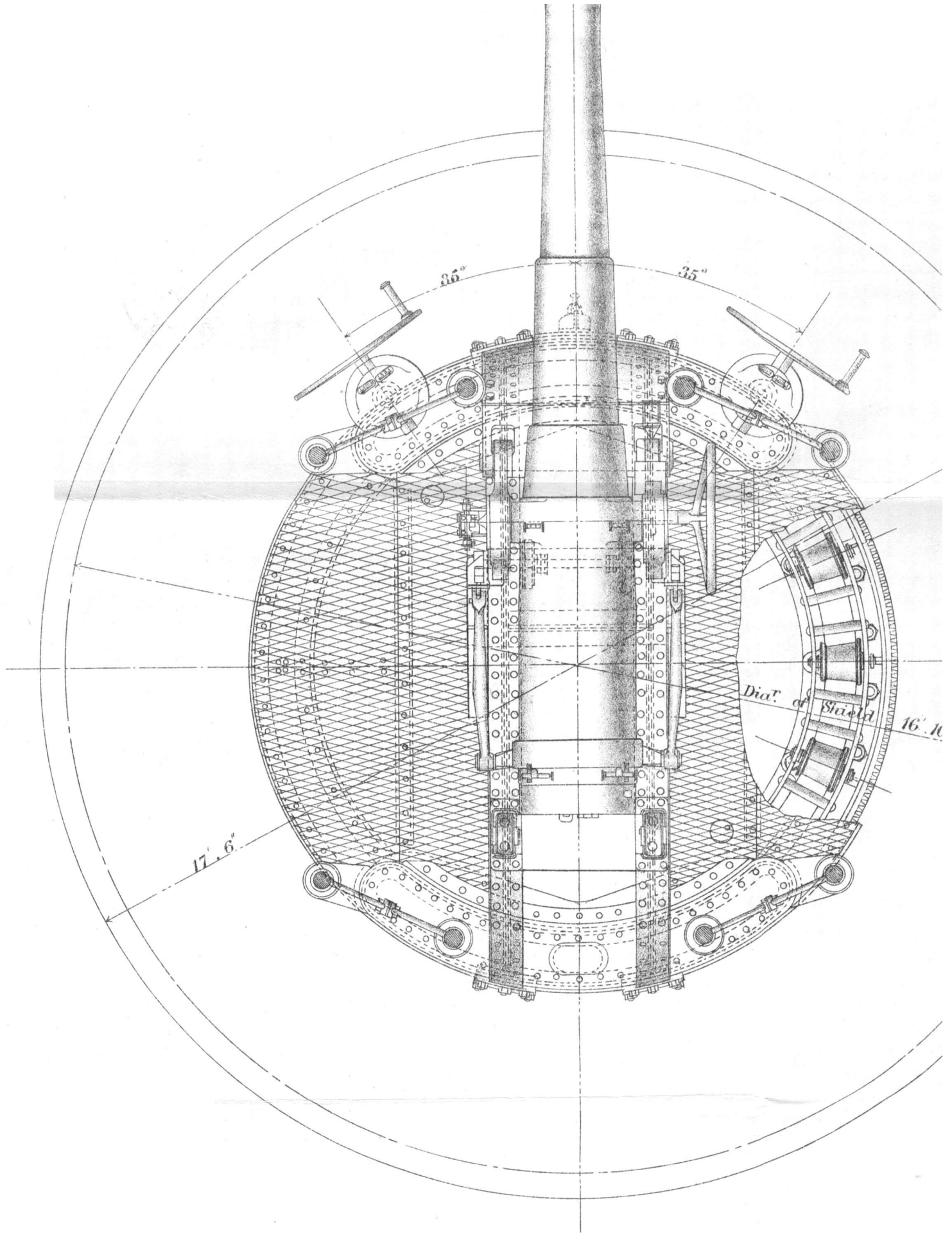
SECTION OF ELEVATING GEAR.



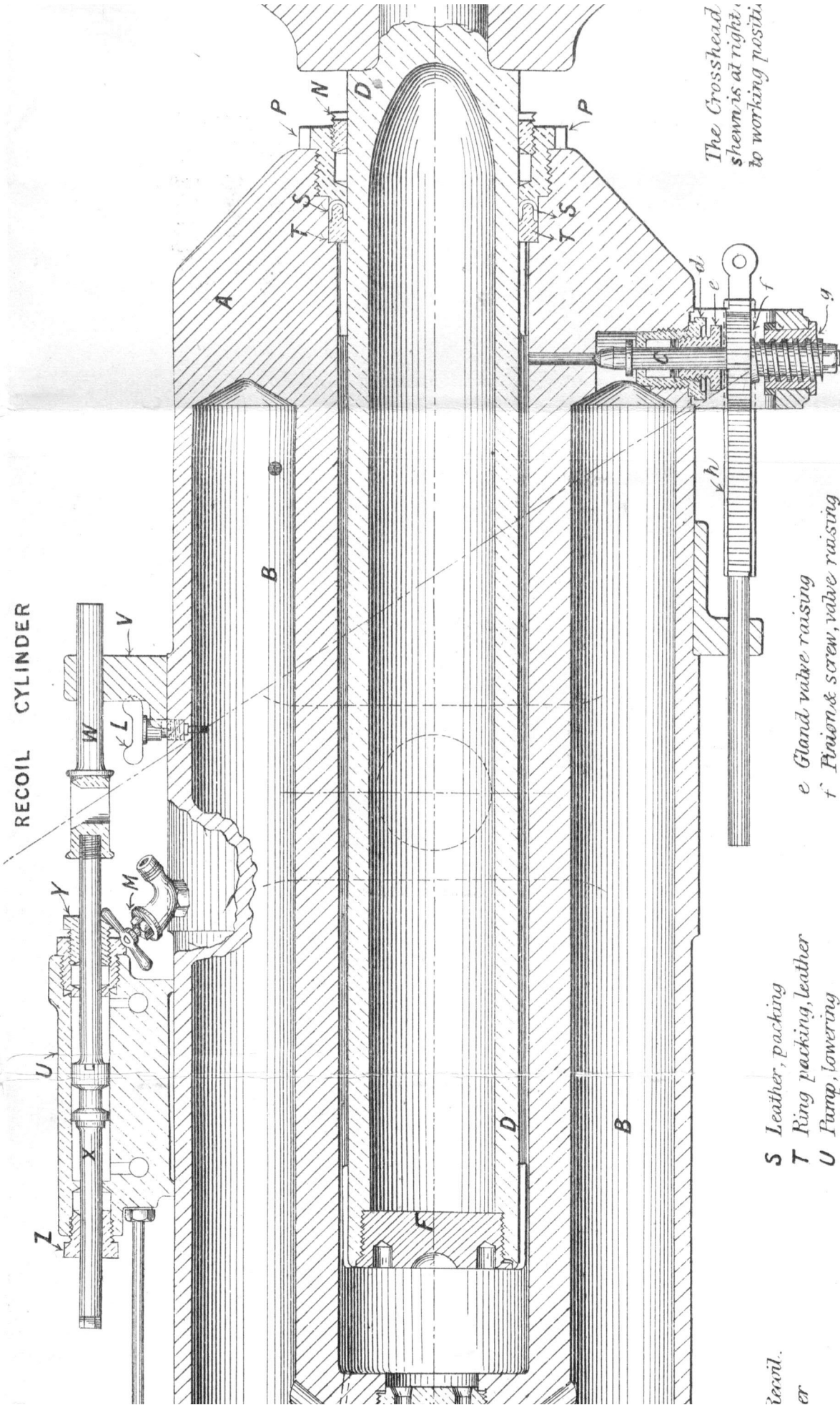
ELEVATION.



PLAN.



(HYDRO PNEUMATIC)



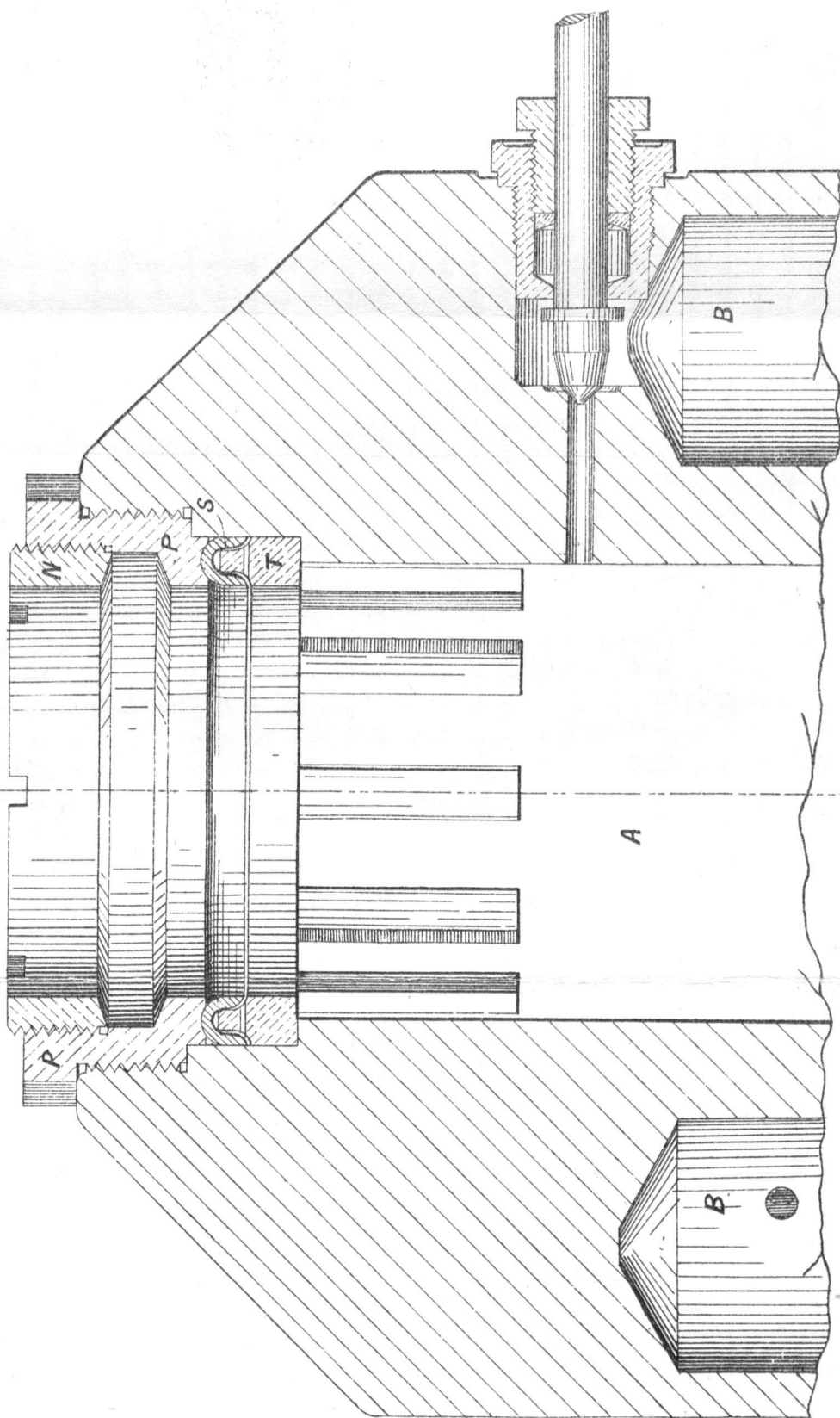
The Crosshead
shown is at right
to working position.

- S Leather, packing
- T Ring packing, leather
- U Pump, lowering
- V Bracket, guide, piston
- W Rod, guide, piston/rod
- X " piston
- Y Gland, rod piston, top
- Z " " bottom
- e Gland valve raising
- f Flange & screw, valve raising
- g Nut screw valve raising
- h Back valve raising
- i Valve recoil
- j Seatings, valve recoil
- k Springs
- m Bottom chamber
- n Valve recoil
- o Valve recoil

GARRISON DISAPPEARING B.L. 6-INCH MARK IV

(HYDRO PNEUMATIC)

RECOIL CYLINDER

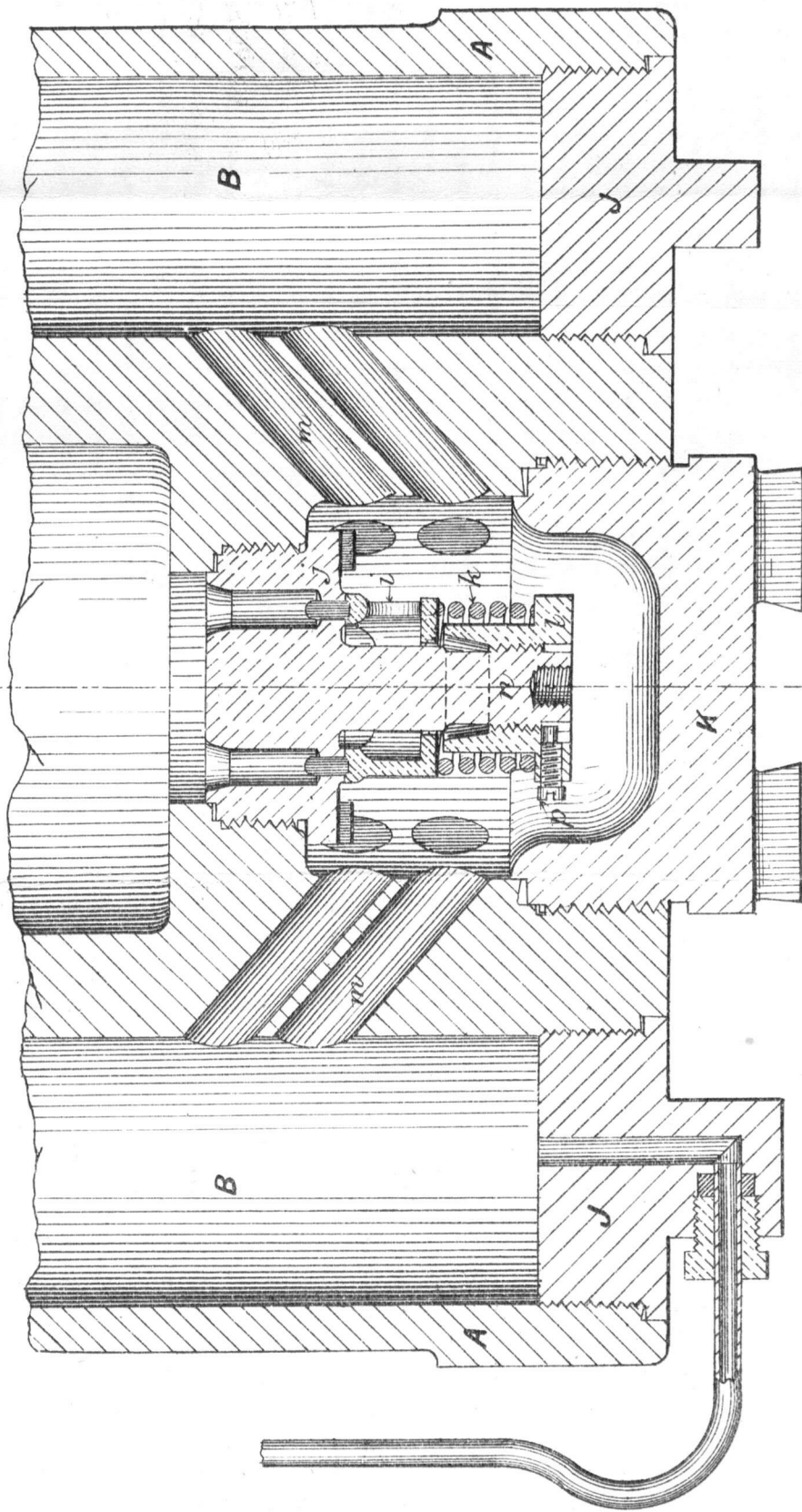


- A Cylinder recoil
- B Air Chamber
- N Gland inner
- P Gland outer cylinder recoil
- S Leather packing
- T Ring packing leather

CARRIAGE GARRISON DISAPPEARING B.L. 6-INCH MARK IV

(HYDRO-PNEUMATIC)

RECOIL CYLINDER



A Cylinder, Recoil.

B Air-chamber.

J Plug air chamber.

K - chamber valve recoil.

i Valve recoil.

j Seatings, valve recoil.

k Springs valve recoil.

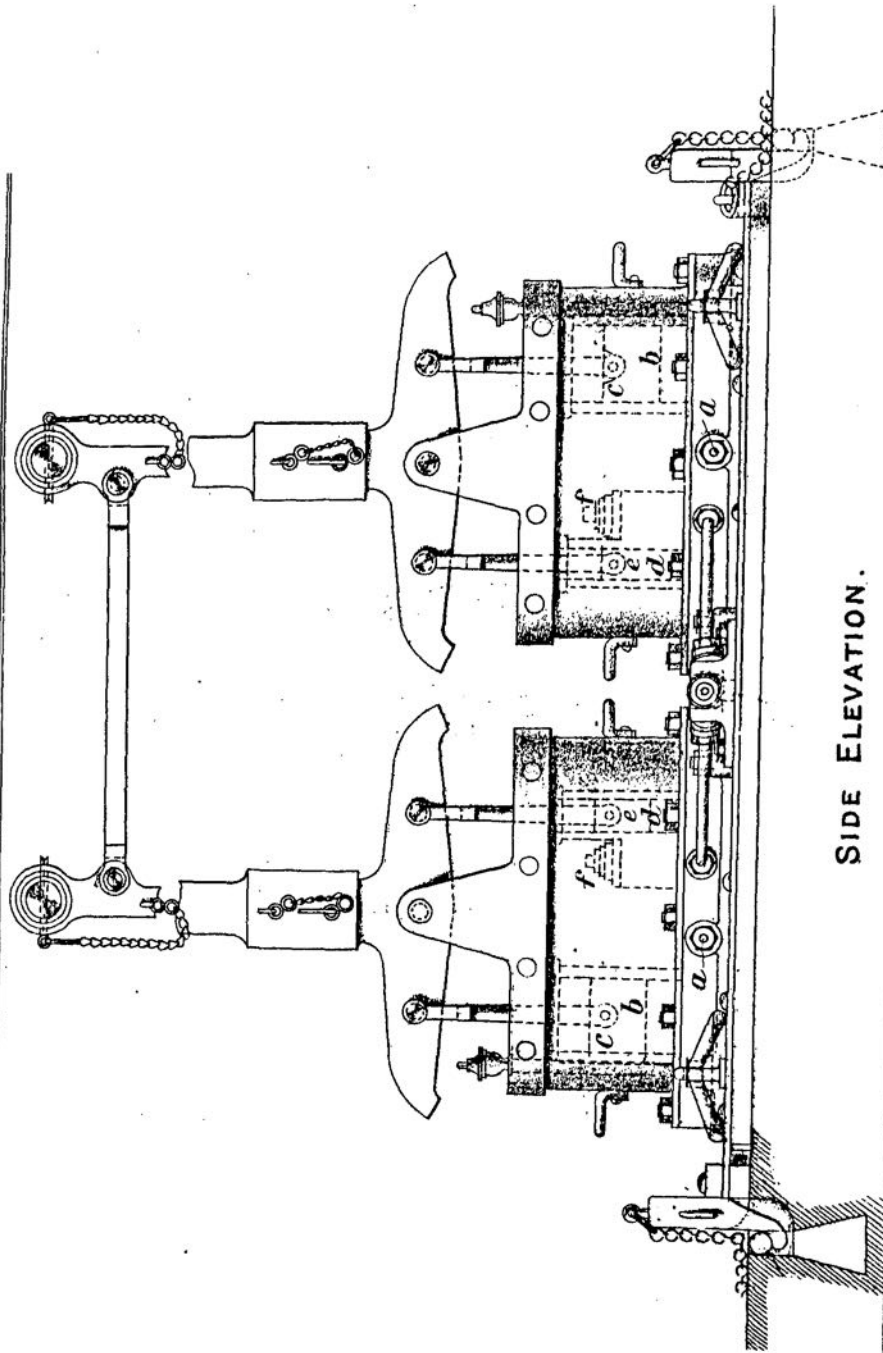
v Nut adjusting valve recoil.

n Passages to air chamber.

p Spindle valve recoil.

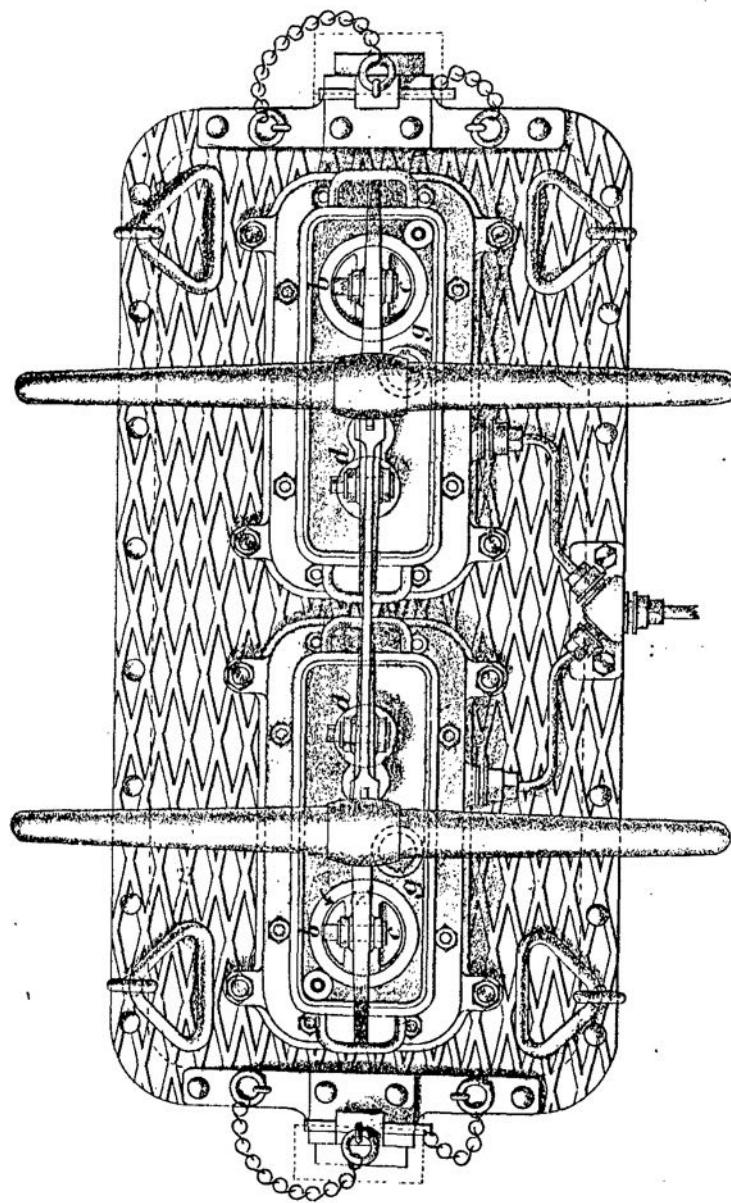
p Screw set nut adjusting valve recoil.

PUMP, AIR, DOUBLE, CARRIAGE, GARRISON, D.C.



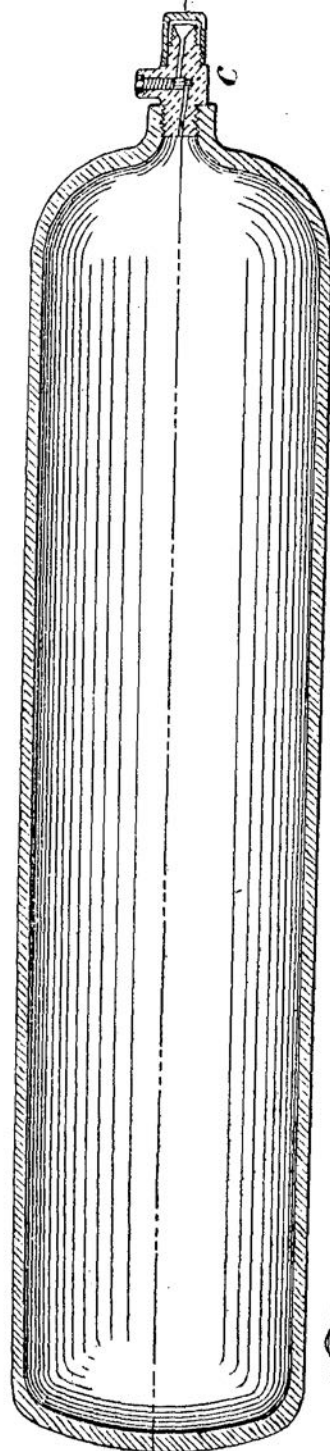
SIDE ELEVATION.

PUMP, AIR, DOUBLE CARRIAGE, GARRISON, DISAPPEARING, MARK I

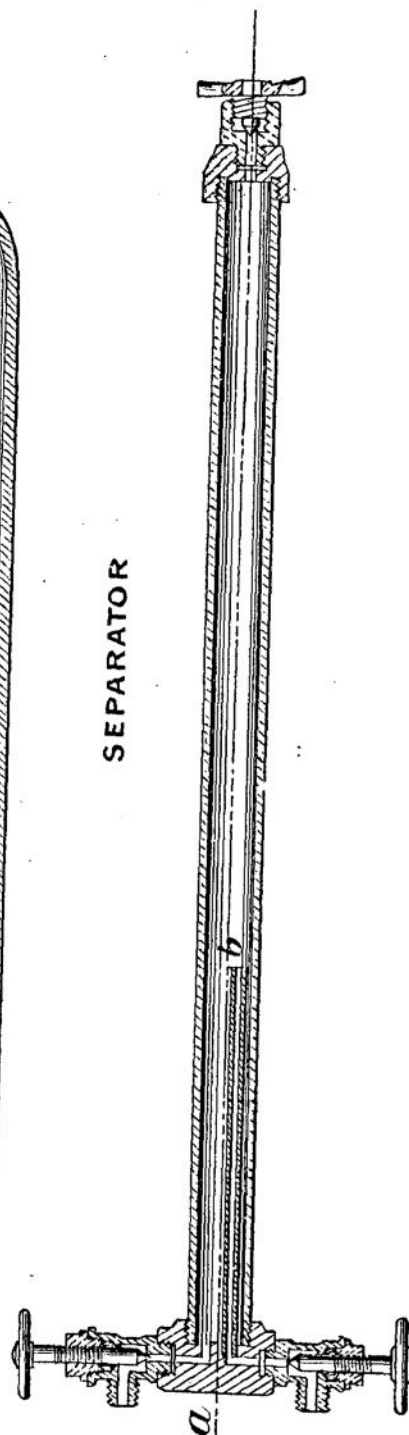


TOP PLAN.

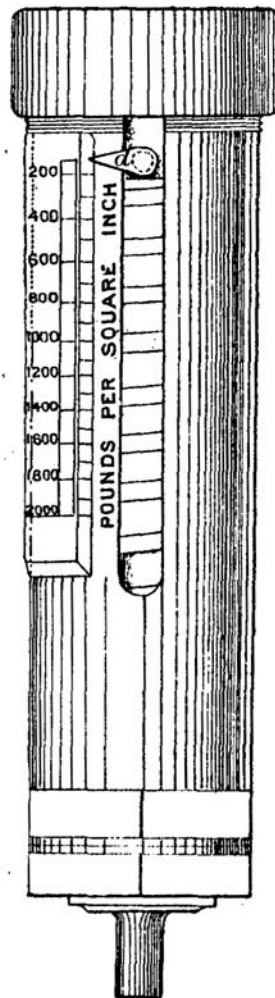
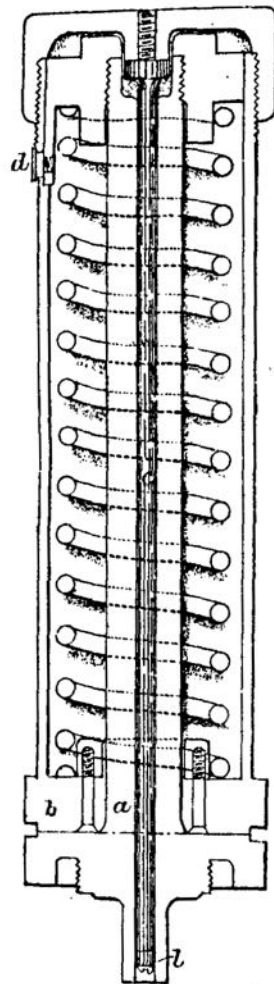
RESERVOIR FOR COMPRESSED AIR



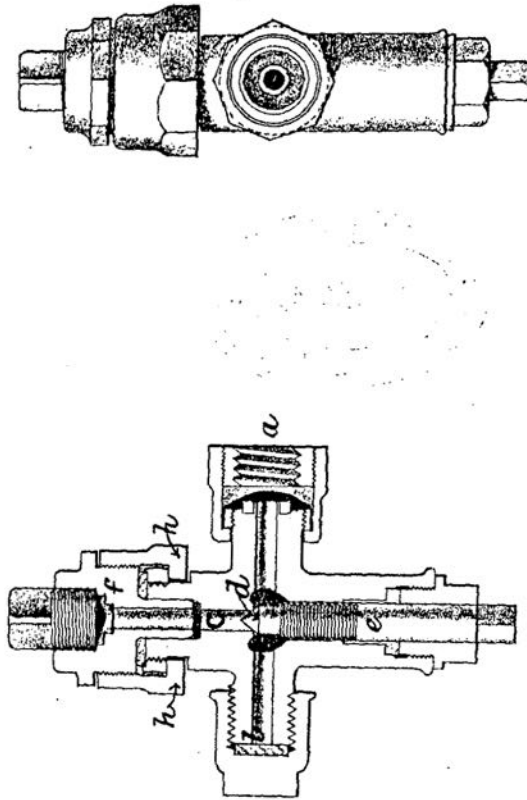
SEPARATOR



INDICATOR, PRESSURE SPRING. MARK I.

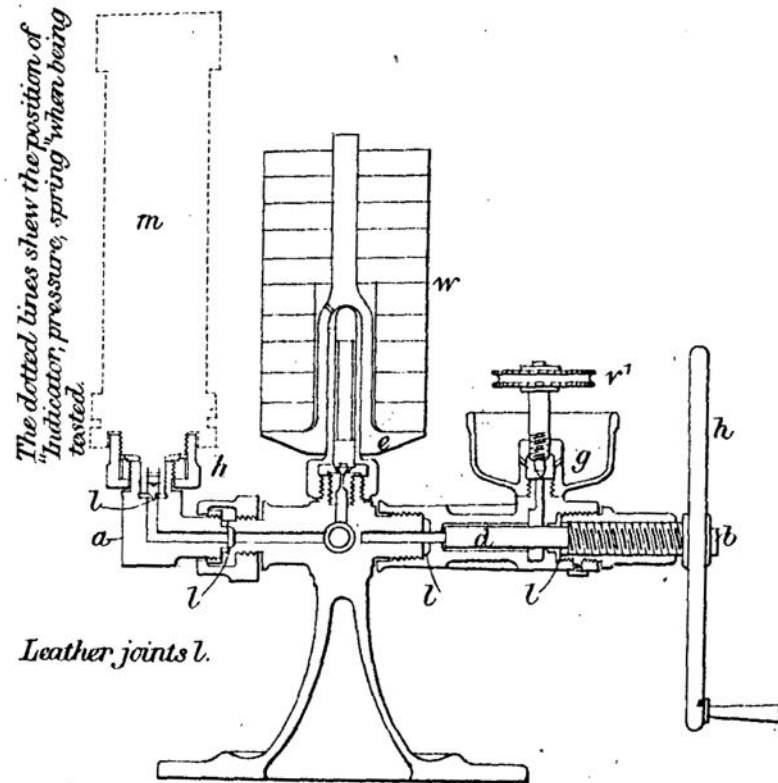


CONNECTION, INDICATOR, PRESSURE, CARRIAGE, GARRISON, DISAPPEARING.

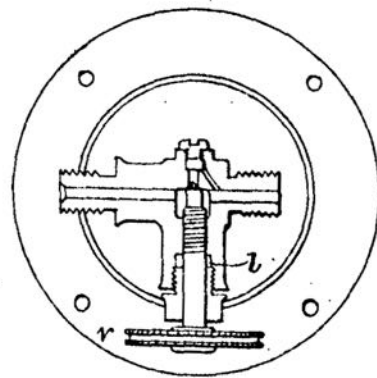


GAUGE, PRESSURE, DEAD WEIGHT TESTING.

MARK I.



SECTIONAL ELEVATION.

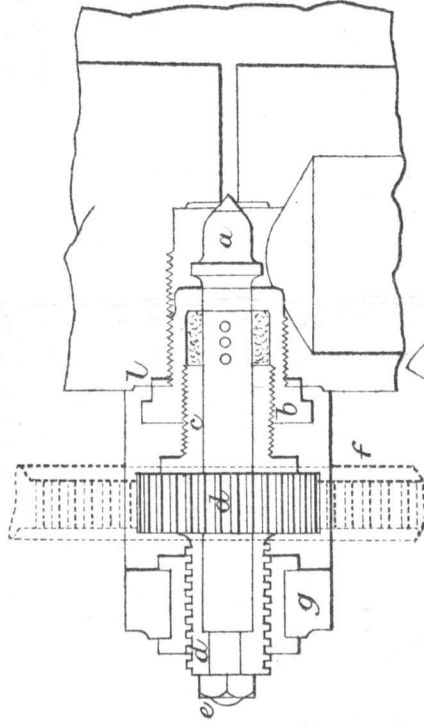


SECTIONAL PLAN THROUGH *a. b.*

CARRIAGE, GARRISON, DISAPPEARING HYDRO-PNEUMATIC.

6 INCH B. L. MARKS II TO IV.

RAISING VALVE.



RECOIL VALVE.

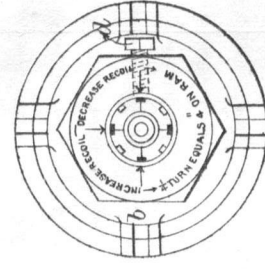
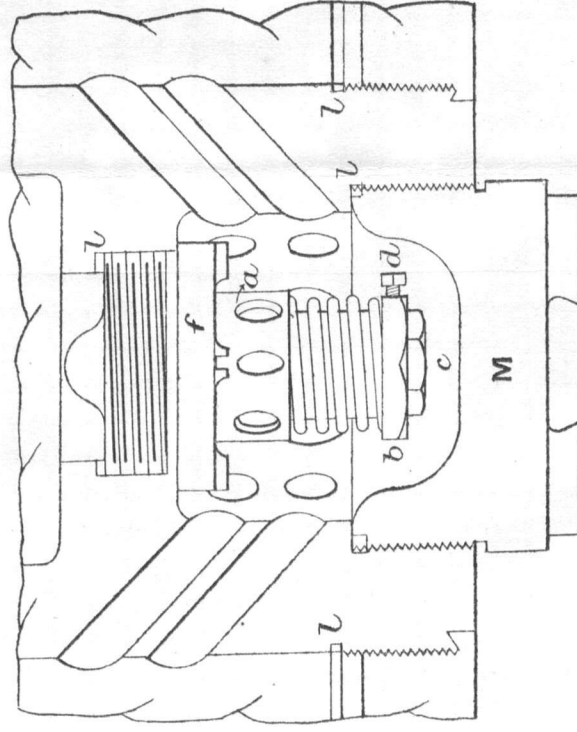


Fig. II.

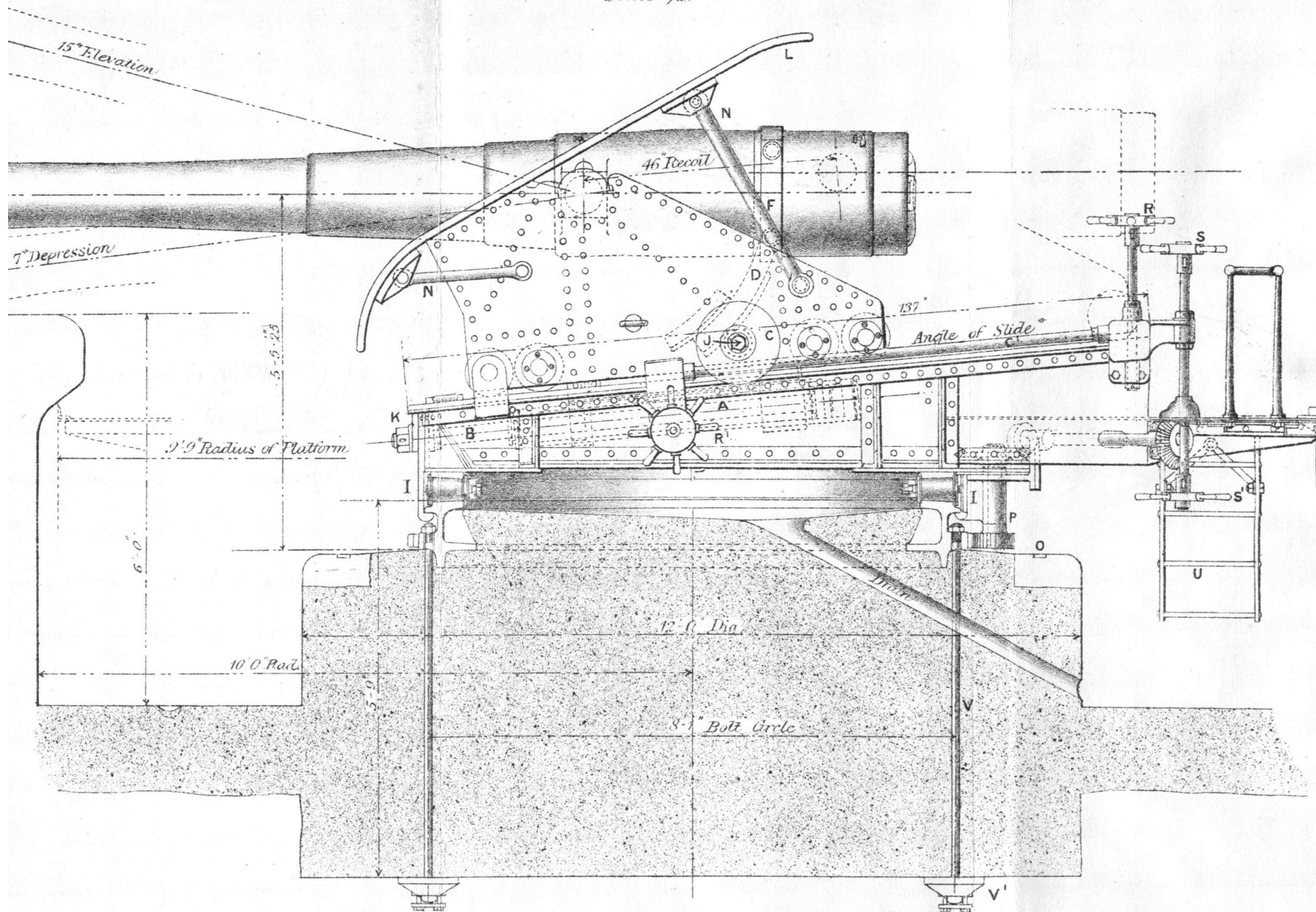
PLAN WITH "C" REMOVED.

Fig. I.

l. Leather washers.

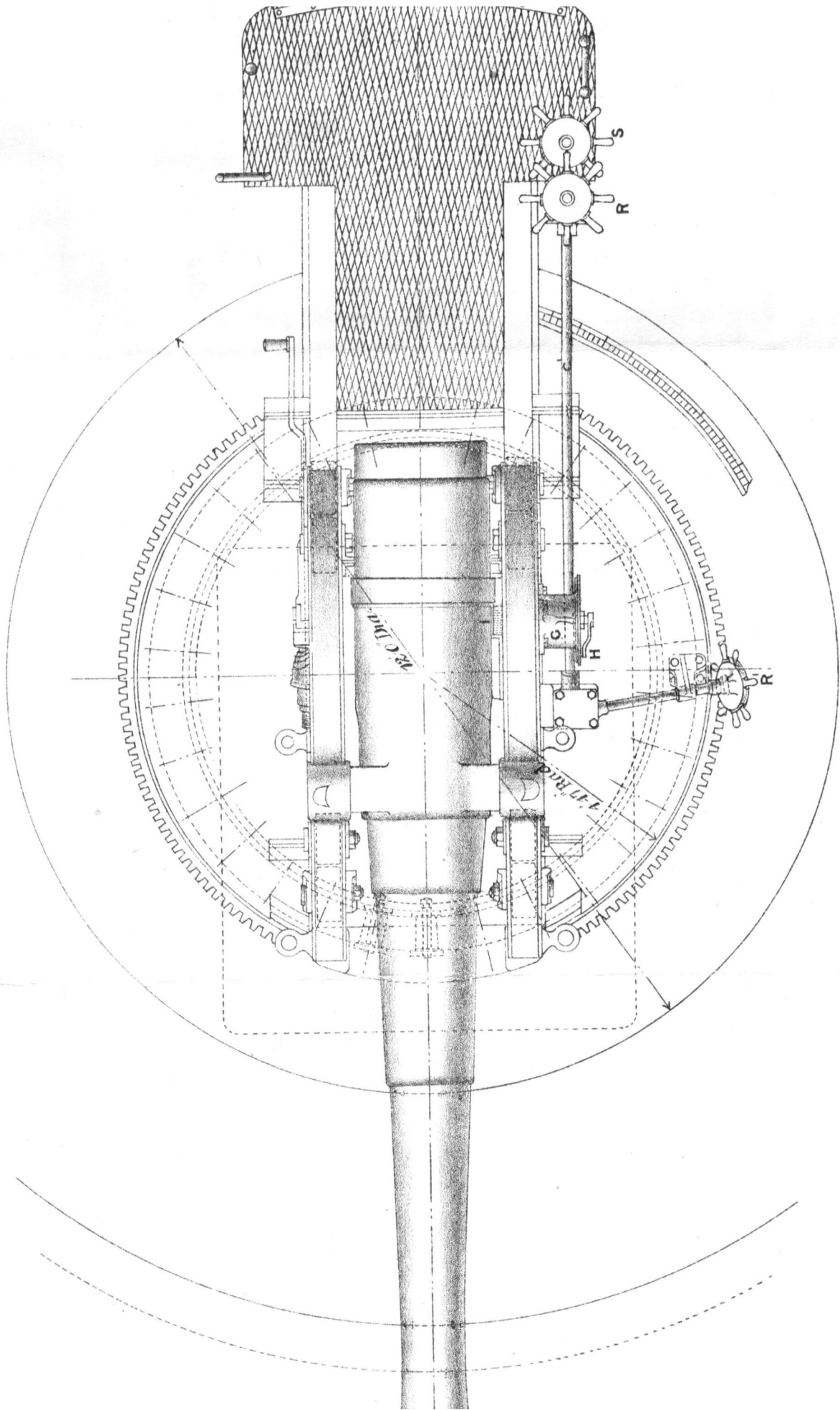
CARRIAGE GARRISON BARBETTE B.L.6 INCH MARK I ON SLIDE L.B.L.6 INCH BARBETTE MARK I.

Scale $\frac{1}{24}$



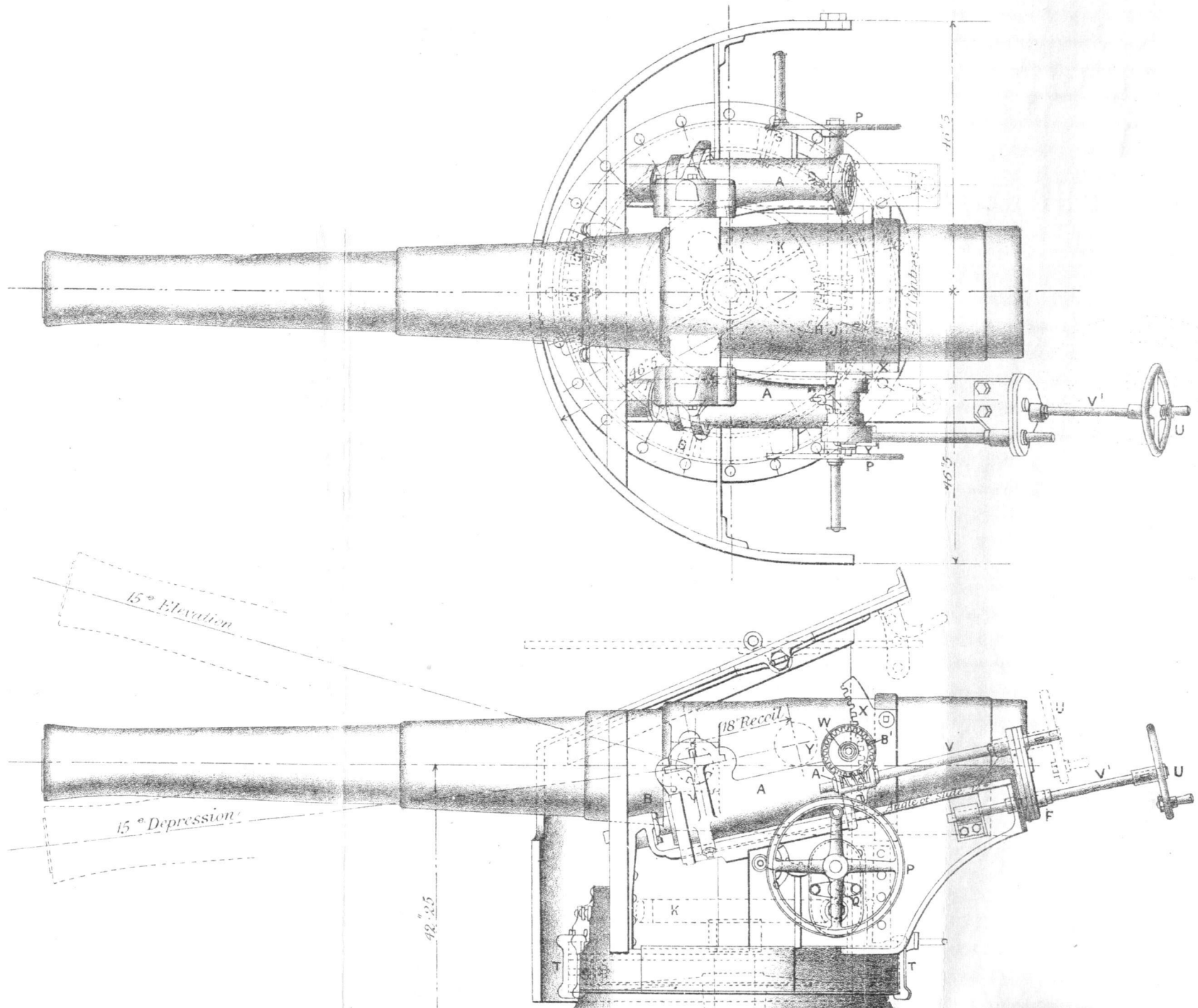
CARRIAGE GARRISON BARBETTE B.L.6 INCH MARK I
ON
SLIDE L.B.L.6 INCH BARBETTE MARK I.

Scale $\frac{1}{32}$



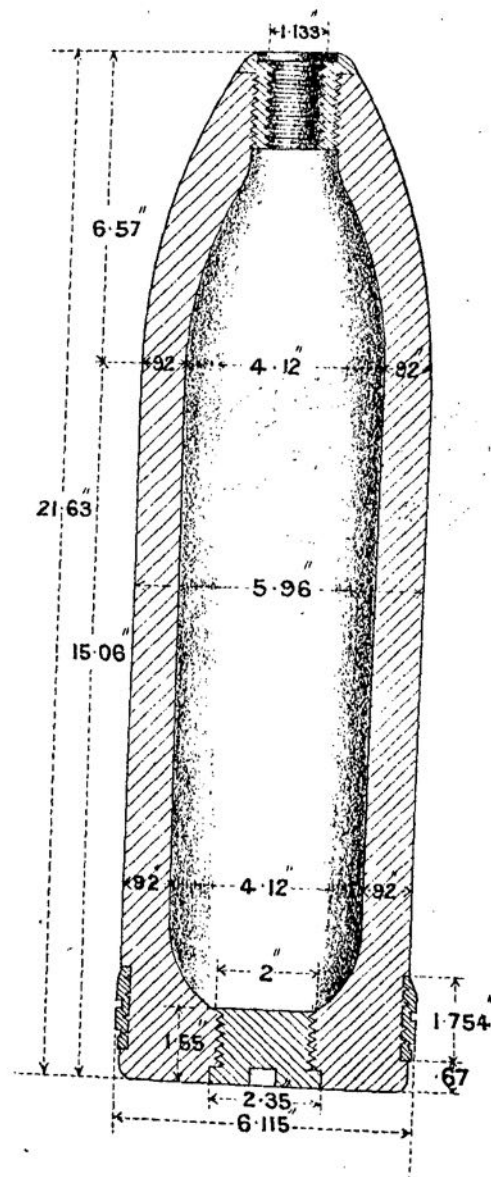
CARRIAGE GARRISON B.L. 6 INCH VAVASSEUR CENTRAL PIVOT MARK I

Scale $\frac{1}{24}$



SHELL B. L. COMMON, 6-INCH,
CAST-STEEL (MARK VI.)

SCALE $\frac{1}{4}$.

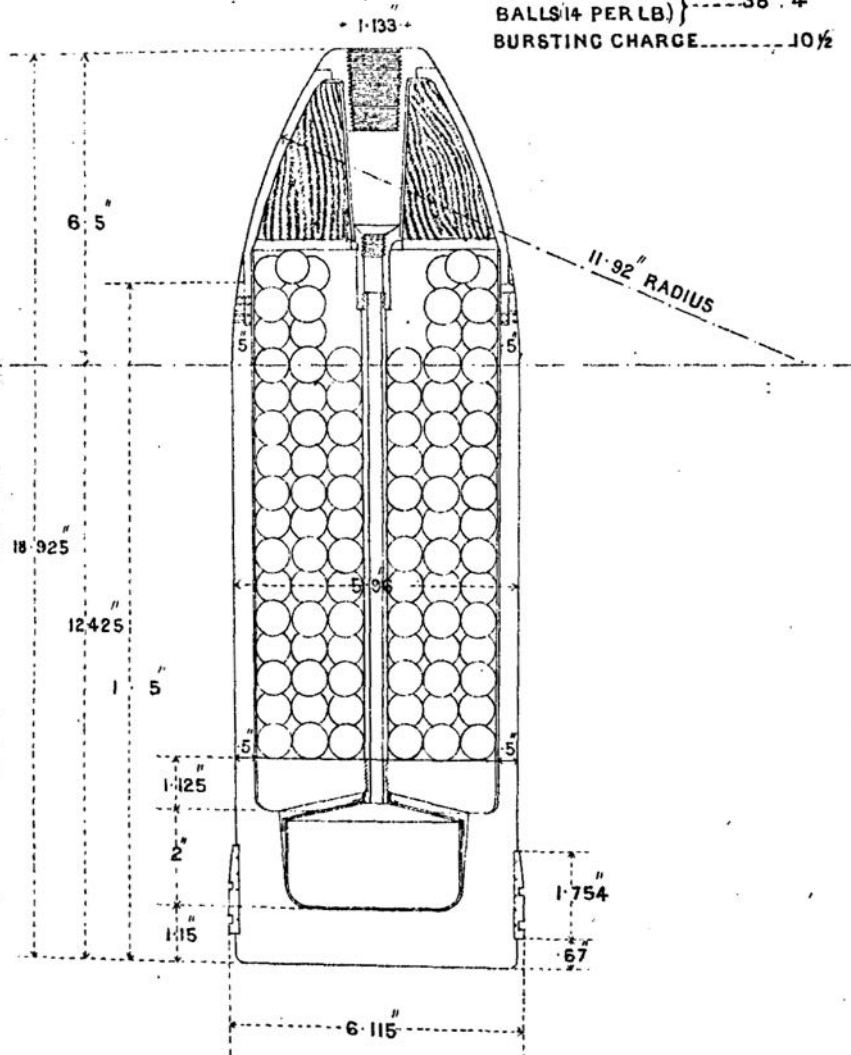


HELL B. L. SHRAPNEL 6 INCH FORCED STEEL.

MARK IV.

SCALE $\frac{1}{4}$.

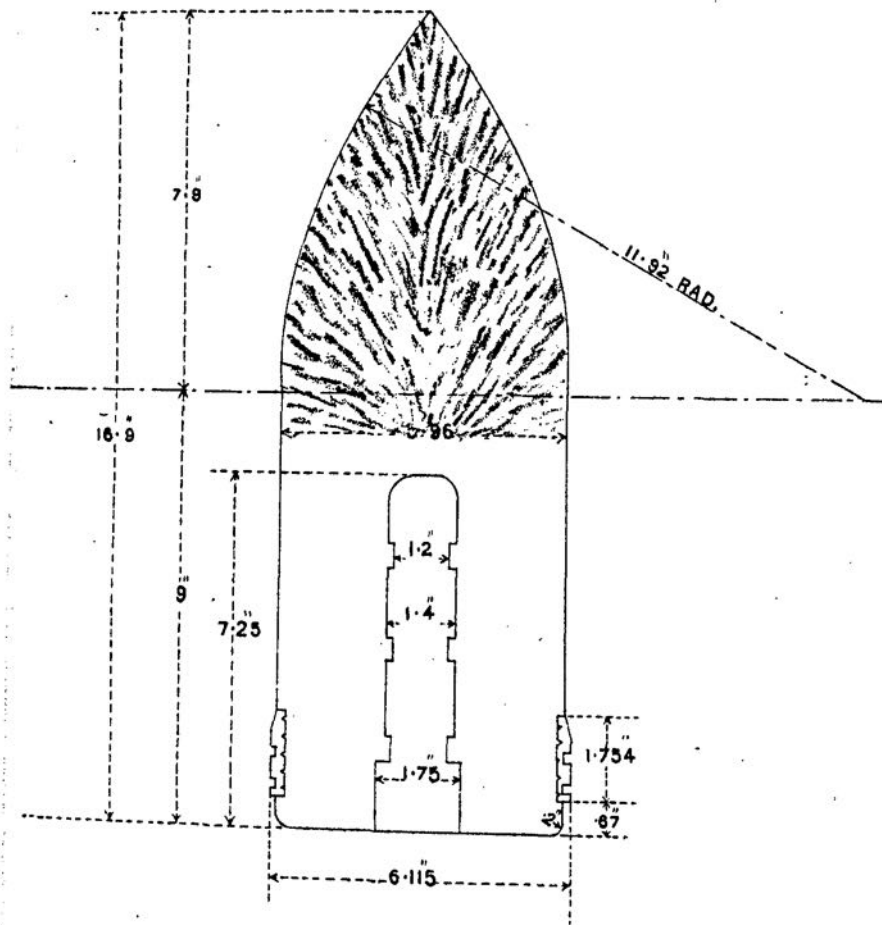
	LB. OZS.
TOTAL WEIGHT.....	100 . 8
536 MIXED METAL	} 38 . 4
BALLS (14 PER LB.)	
BURSTING CHARGE.....	10 $\frac{1}{2}$



SHOT B.L. PALLISER 6 INCH MARK V.

SCALE $\frac{1}{4}$

TOTAL WEIGHT = 100.^{LB.}



SHELL B.L. ARMOUR PIERCING 6 INCH MARK I

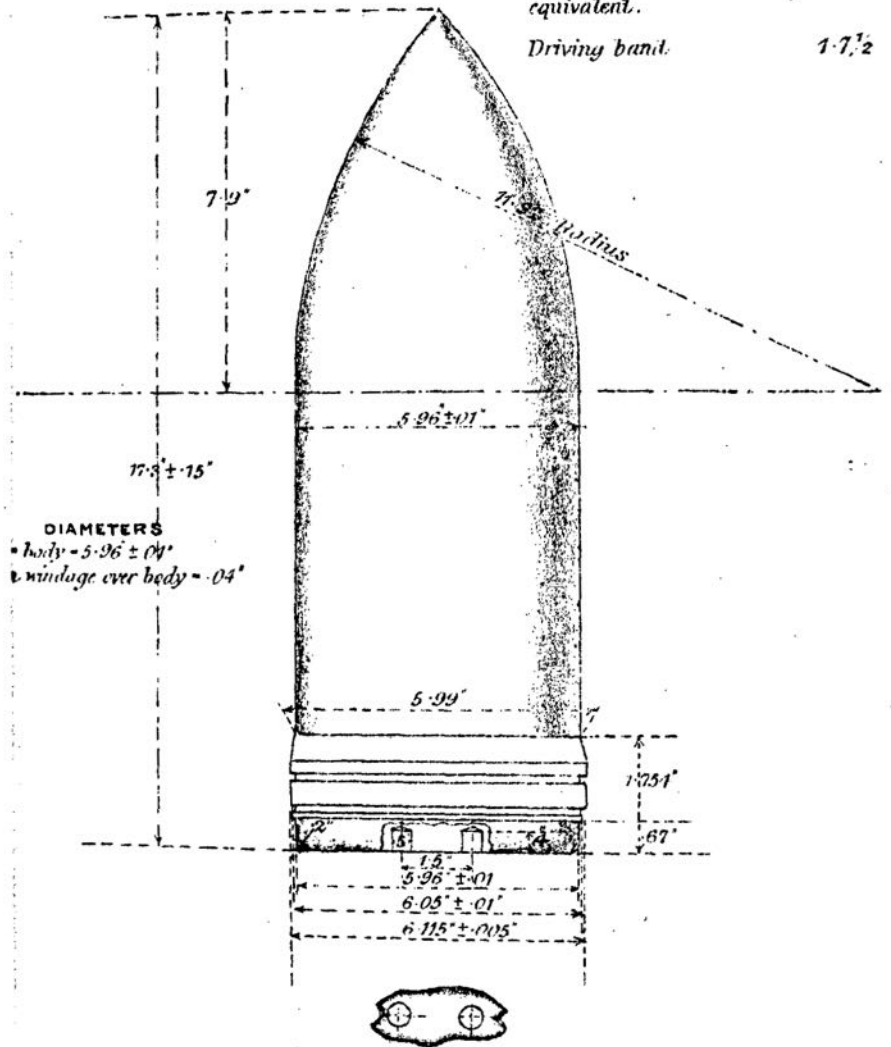
FORGED STEEL

Scale 3" = 1 Foot
Radius of Head = 2 Diameters

Average total weight of
projectile including driving
band and burster or its
equivalent.

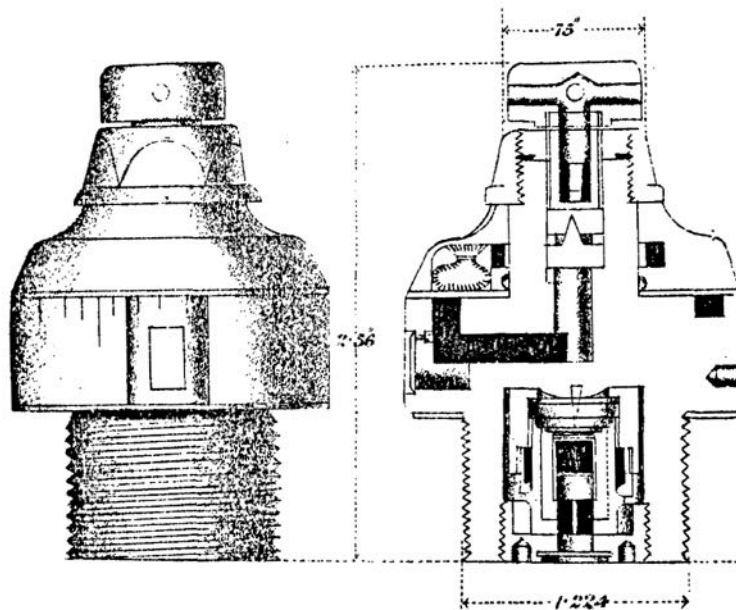
16 038
100.0 ± 2%

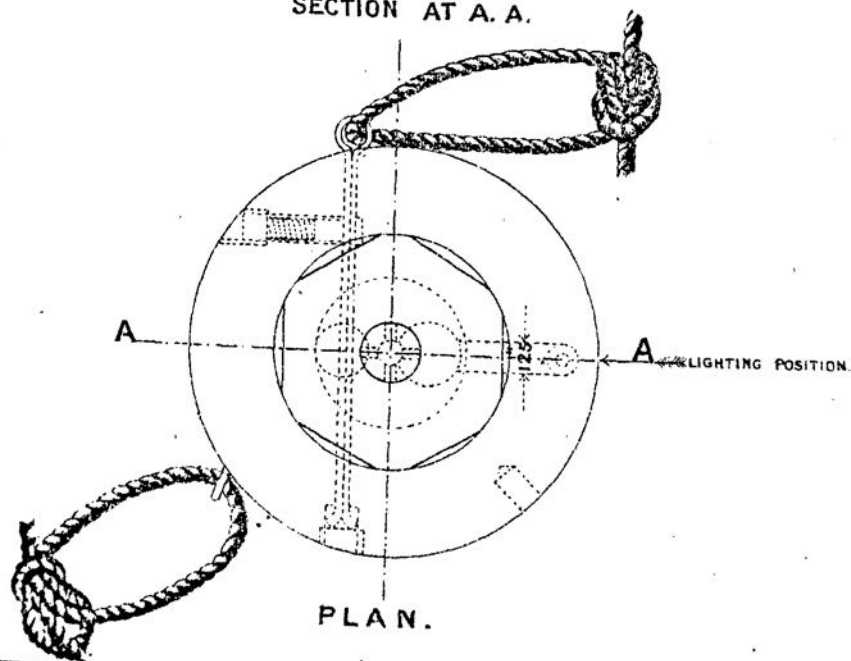
Driving band 1.7 1/2



PART PLAN OF BASE

FUZE TIME AND CONCUSSION MEDIUM MARK II.
FULL SIZE.



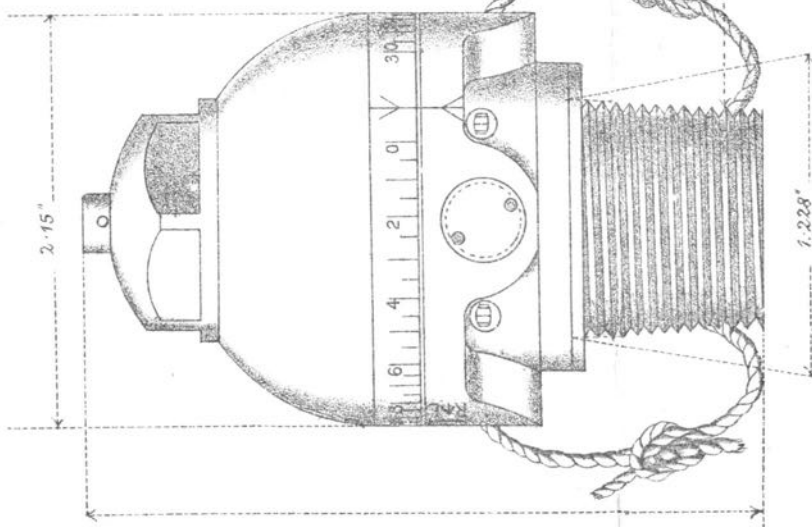
$$5346 \overline{) 589.}$$


face page 112

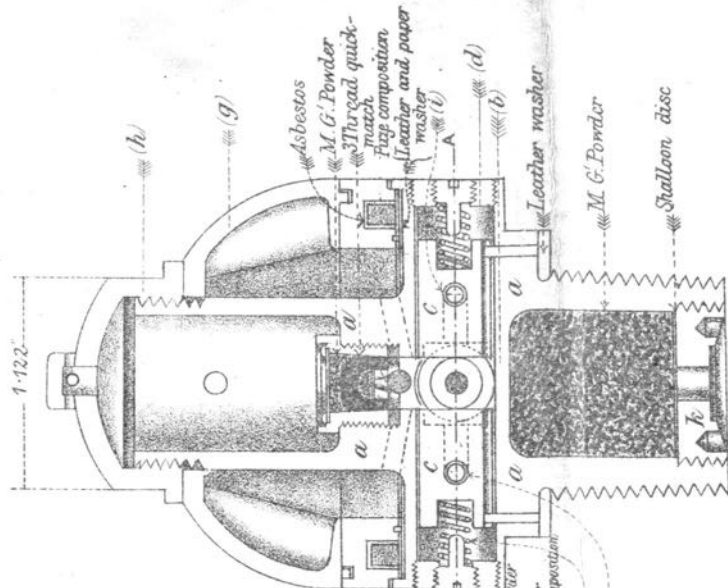
FUZE TIME, SENSITIVE MIDDLE. NO 24. MARK I.

SCALE $\frac{1}{1}$

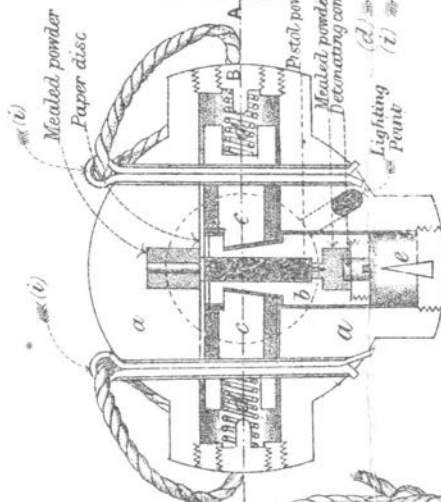
WEIGHT 1 LB. 4 OZ.



ELEVATION SET AT 'SAFETY'



SECTION AT B.B.

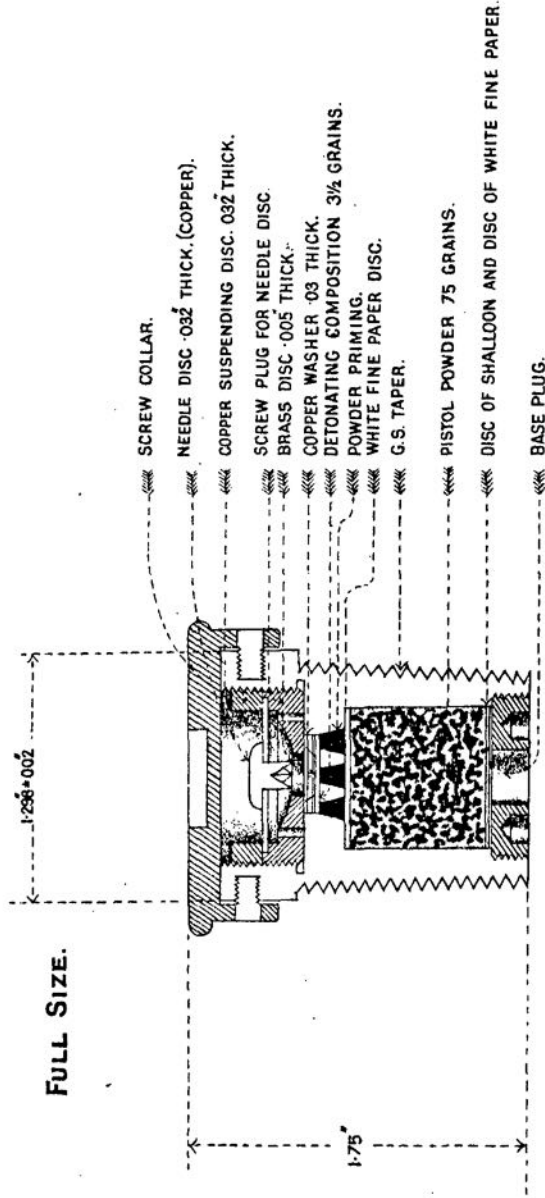


SECTION AT A.A.

G.S. Fuze hole gauge

FUZE, PERCUSSION, DIRECT ACTION, N: 3. MARK

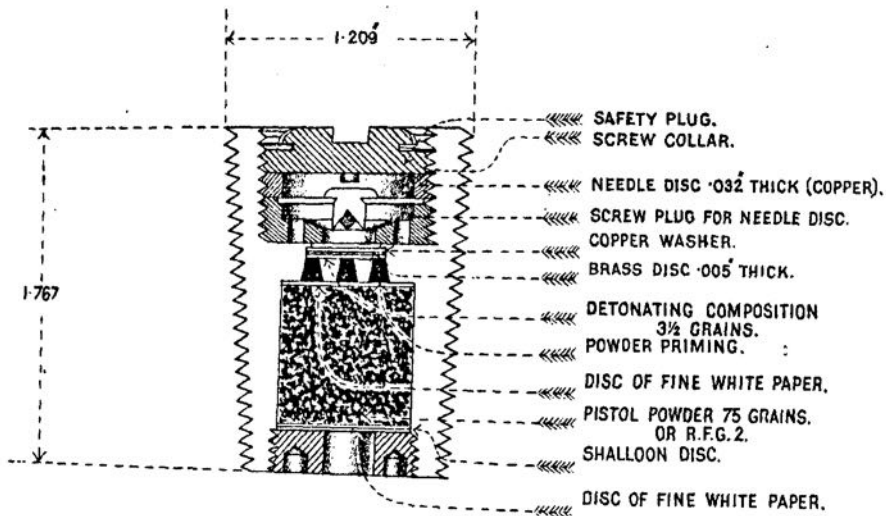
METAL 5 IN A TIN CYLINDER.



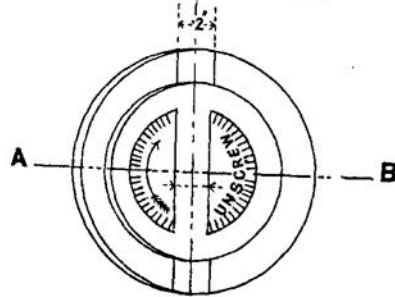
FUZE, PERCUSSION, DIRECT ACTION N° 3. MARK III.

METAL 5 IN A TIN CYLINDER.

FULL SIZE.



SECTION AT A.B.

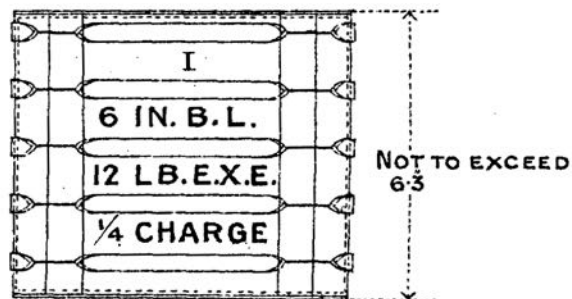


CARTRIDGE B.L. 6 INCH 12 LB. E.X.E. MARK I.

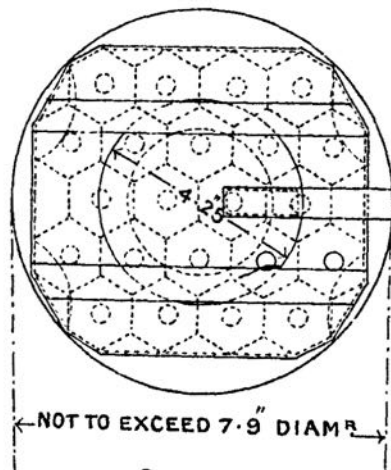
SILK CLOTH $\frac{1}{4}$ CHARGE FULL.

MARK IV & VI GUNS.

Scale $\frac{1}{4}$.



ELEVATION .

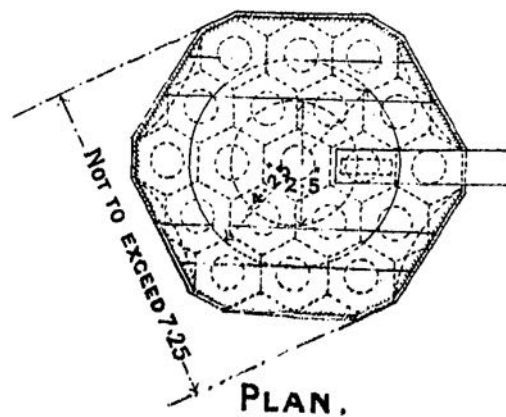
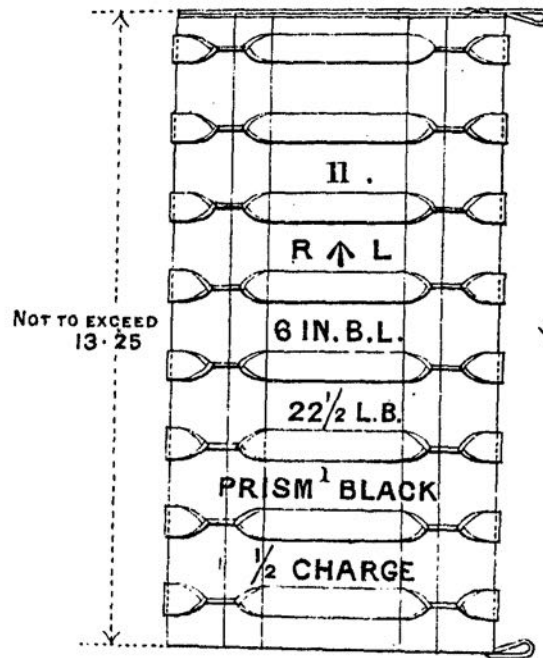


PLAN

ARTILLERY CARTRIDGE B. L. 6 22 $\frac{1}{2}$ LB. PRISM! BLACK.

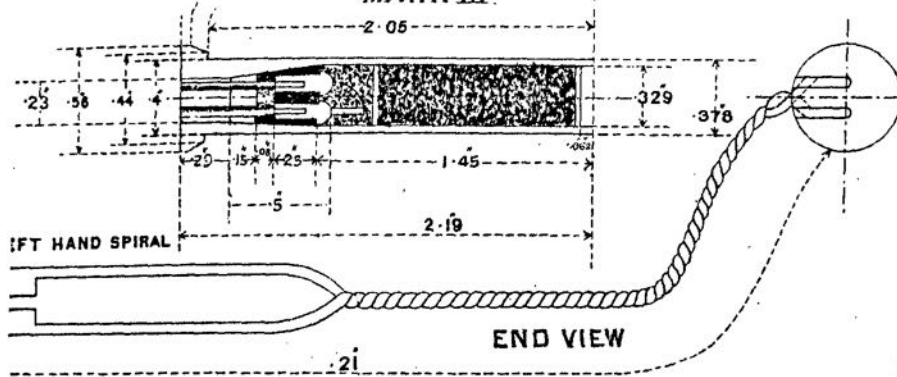
MARK II. (FOR MARK V GUNS.)

$\frac{1}{4}$ SIZE.

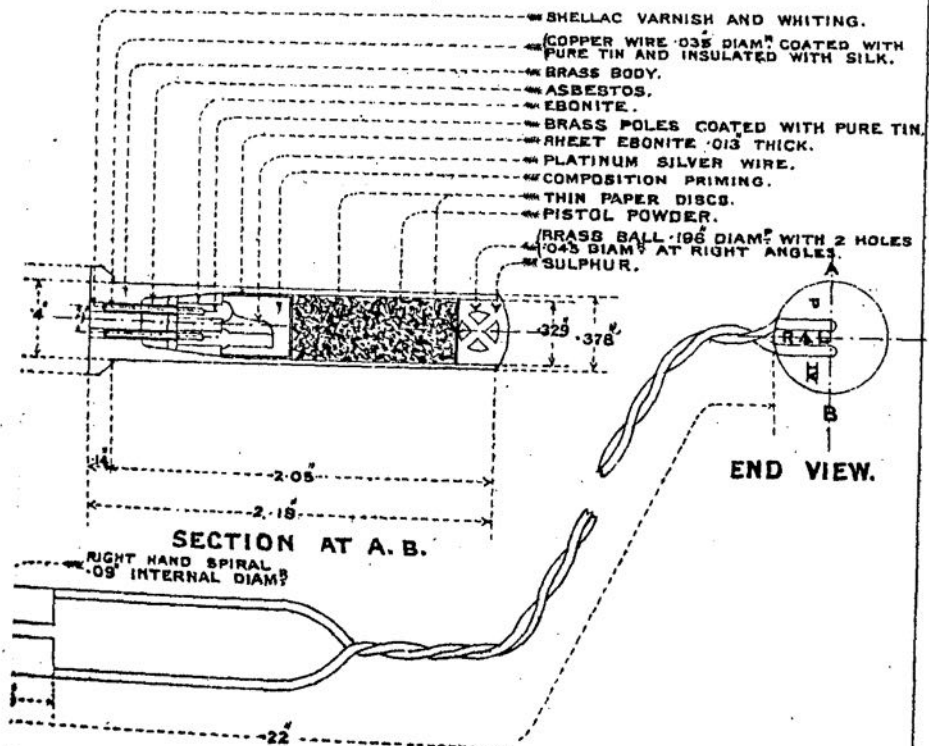


TUBES VENT SEALING ELECTRIC MARKS III & IV.
BRASS FOR GUNS WITH PERCUSSION LOCKS.
SECTIONS (FULL SIZE)

MARK III.



MARK IV

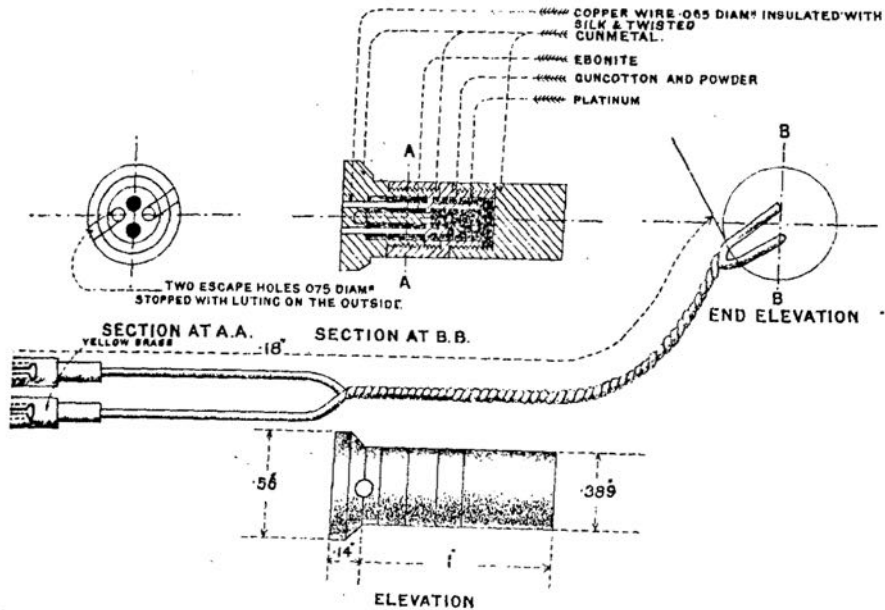


BES VENT SEALING ELECTRIC P DRILL MARKS I&III.

GUNMETAL, FOR GUNS WITH PERCUSSION LOCKS.

FULL SIZE.

MARK I



MARK III

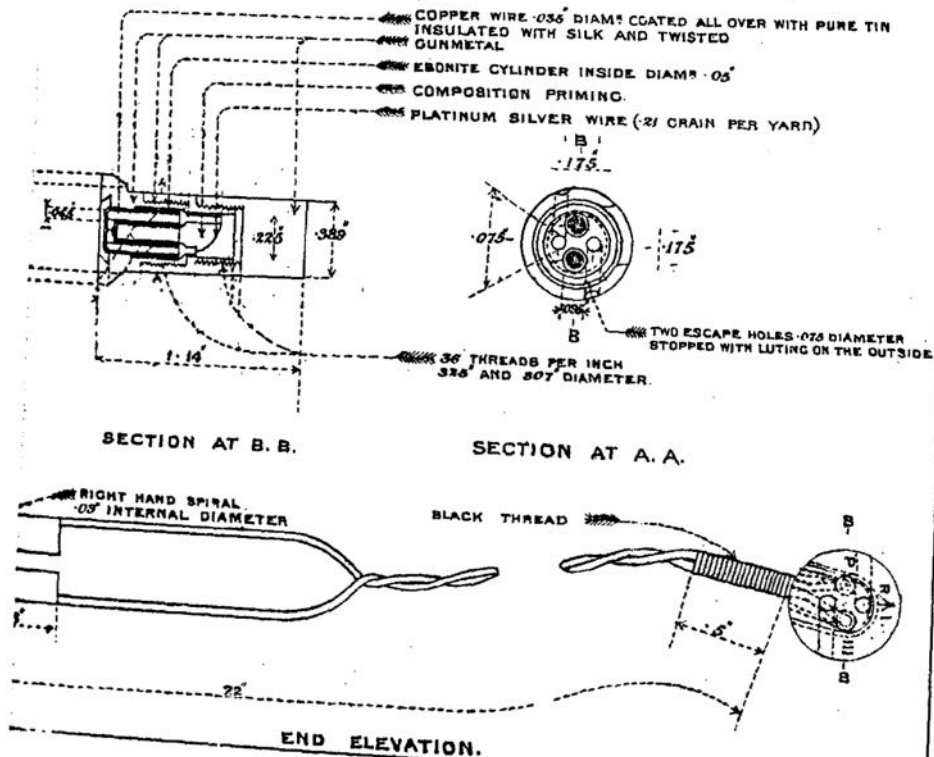


Diagram illustrating the components and dimensions of a Mark II percussion cap assembly:

- BRASS WASHER .045" THICK.
- BRASS STRIKER .2" DIAM.
- CARTRIDGE METAL BODY.
- COPPER PERCUSSION CAP.
- BRASS ANVIL .25" DIAM.
- COPPER DISC .01" THICK.
- LOOSE POWDER.
- PAPER DISCS.
- CORK PLUG.

Dimensions shown in the diagram:

- Overall length: 2.05
- Length of the cap body: 2.19
- Length of the cap body (alternative measurement): 1.32
- Length of the cap body (alternative measurement): .078

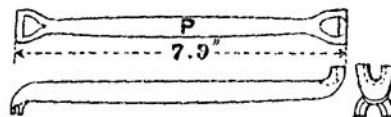
BRASS WASHER .046 THICK.
 BRASS BODY.
 BRASS STRIKER .2" DIAM^T
 COPPER PERCUSSION CAP .1975" DIAM^T
 BRASS ANVIL .25" DIAM^T SCREWED 36 THREADS
 PER INCH RIGHT HAND.
 COPPER WASHER .01 THICK.
 PAPER DISCS.
 PISTOL POWDER.
 BRASS BALL .196" DIAM^N WITH 2 HOLES .046"
 DIAM^T AT RIGHT ANGLES.
 SULPHUR.

2 HOLES .085" DIAM^T

.05" DIAM^T OF HOLE

14
 2.05
 2.19

EXTRACTOR TUBE P (MARK I.)
STEEL VENT SEALING, PERCUSSION.



EXTRACTOR TUBE P SPECIAL (MARK I.)
STEEL VENT SEALING PERCUSSION

SCALE $\frac{1}{4}$

